PHILIPS

PHILIPS

Multimeter
PM2525

ST & MEASUREMENT CUSTOMER SUPPORT

Electronic Services - Ha
M19482,

4822 872 35308
880325 (all versions)

Service Manual

Multimeter
PM2525

Service Manual

4822 872 35308
880325 (all versions)

ST5237

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IMPORTANT

In all correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

This service manual can be used for the following versions;

PM2525/01	PM2525/013	PM2525/014	PM2525/015
/21	/213	/214	/215
/51	/513	/514	/515
/61	/613	/614	/615
/61	/713	/714	/715
EUROPE	USA	United Kingdom	Switzerland

The PM2525/..3 USA versions are delivered with mother p.c. board b.

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1. SAFETY INSTRUCTIONS

Read this page carefully before installation and use of the instrument.

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
Adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

1.1 GENERAL CLAUSES

1.1.1 WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to life.

1.1.2 The instrument shall be disconnected from all voltage sources before it is opened.

1.1.3 Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

1.1.4 WARNING: Any interruption of the protective earth conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

1.1.5 Components that are important for the safety of the instrument may only be renewed by components obtained through your local Philips organisation.

1.1.6 After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in Section 7 must be performed.

2 CHARACTERISTICS

General notes:

1. Specification points, marked with ** apply only for the PM2525/51 and PM2525/61.
2. This characteristics describes the overlapping specification points from the versions PM2525/01/21/51/61/71.

Safety Characteristics

This apparatus has been designed and tested in accordance with Safety Class 2 requirements of IEC Publication 348. Safety Requirements for Electronic Measuring Apparatus and CSA 556B, and has been supplied in a safe condition.

REMARK: PM2525/01/21 Safety Class 2
PM2525/51/71 Safety Class 1

This manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.

This instrument:
- satisfies the requirements of EEC Council Directive NO. 73/23 EEC in that it conforms with IEC Publication 348.
- is listed by the Canadian Standards Association as certified.
- is certified by the independent German Testing and Approvals Institute VDE (and has been tested according to VDE 0411, Part 1).

Perfomance Characteristics

- Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS. Specified tolerance numerical values indicate those that could be nominally expected from the mean of a range identical instruments.
  This specification is valid after power on. This instrument needs no warming-up.

Specification for Digital Multimeter PM 2525

(Terms used in these specifications are based on definitions layed down in IEC 458)

General

Manufacturer	: Philips HIG I&E
Type number	: PM 2525
Designation	: Digital Multimeter
Measured functions	: V_{DC}, V_{AC}, V_{AC+DC}, V_{peak}, A_{DC}, A_{AC} Ohm 2w, Ohm 4w, , cont, F, °C, Hz, s

General notes:

1. Specification points, marked with * apply only on the /51 and /61 versions.
2. This specification describes the overlapping specification points of the versions /01, /21, /51, /61 and /71.

Measurement performance

DC voltage measurement

Ranges	: 200 mV - 2000 V (max. input voltage 1000 V
Resolution	:*High speed mode: 100 uV in 200 mV range Normal mode: 10 uV in 200 mV range High resolution mode: 1 uV in 200 mV range
Number of representation units	:*High speed mode: 2100 Normal mode: 21000 High resolution mode: 210000
Accuracy at reference conditons	: ± (0.02% of reading + 0.01% of range)
Temperature coefficient	: ± 0.003% of reading/°C
Input impedance	: 200 mV - 2 V 20 M ohm // 50 pF 20 V 11 M ohm // 80 pF 200 V - 2000 V 10 M ohm // 90 pF
Offset current in input	: < 20 pA
SMRR	:>80 dB for AC signals 50 Hz ± 0.1% >60 dB for AC signals 50 Hz ± 1%
Maximum SM signal	: 2 x range except 2000 V range
CMRR	:>120 dB for DC signals >120 dB for signals 50 Hz ± 0.1%
Max. CM-voltage	: 250 V RMS 350 V peak
Response time	: 0.8 s (without ranging) 1.5 s (with ranging)

Maximum input voltage	: Hi and Lo	1000 V RMS
	Hi and earth	1000 V RMS
	Lo and earth	250 V RMS
Max. V - Hz product of input signal	: 10^7	
Zeroing	: automatically	
Zero point drift	: 0 - 35°C	2 uV/°C
	35° - 45°	10 uV/°C

dB Measurement in DC ranges

Range	: - 77 ... + 62.2 dB (reference resistor 600 ohm). Measured values less then 0.1 mV is displayed as - UL. Measured value > 1000 V is displayed as OL.
0 dB reference	: 1 mV in reference resistor or when selecting the zero function with push button "zero" on/off.
Reference resistor	: programmable between 0.0001 ohm and 9999 ohm.
Resolution	: 0.1 dB for signals > 1 mV 1 dB for signals < 1 mV
Number of representation units	: 999 for signals > 1 mV 99 for signals < 1 mV
Accuracy signals > 1 mV	: $\pm$ 0.2 dB
signals < 1 mV	$\pm$ 1 dB
Temperature coefficient	: $\pm$ 0.0013 dB/°C
Input impedance for signals between	: 0 ... 1.8 V 20 M // 50 pF
	1.8 V ... 18 V 11 M // 80 pF
	18 V ... 600 V 10 M // 90 pF
CMRR	: > 120 dB for DC signals
	: > 120 dB for AC signals 50 Hz $\pm$ 0.1%
Response time	: 1.5 s

AC voltage measurements

Possible measuring modes	: AC voltage excl. DC component (V~) AC voltage incl. DC component (V≈)
Ranges	: 200 mV - 2000 V (max. input voltage 600 V RMS)
Resolution	:*High speed mode: 100 uV on 200 mV range Normal mode 10 uV on 200 mV range. Measured value under 0.5% of range is displayed as 0000
Number of representation units	:*High speed mode: 2100 Normal mode: 21000

Function V~

Accuracy at reference conditions
over 3% - 100% of range
Ranges 2 V, 20 V and 200 V.
40 Hz - 100 Hz : ± (0.3% of reading + 0.1% of range)
100 Hz - 20 KHz : ± (1% of reading + 0.1% of range)
20 KHz - 100 KHz : ± (5% of reading + 0.5% of range)
Range 200 mV
40 Hz - 100 Hz : ± (0.3% of reading + 0.1% of range)
100 Hz - 20 KHz : ± (1% of reading + 0.5% of range)
20 KHz - 100 KHz ± 2 dB
Range 2000 V
40 Hz ... 60 Hz : ± (0.3% of reading + 0.1% of range)

Function V≂

Accuracy at reference conditions : same as V~
Additional for DC component:
± (0.2% of reading + 0.1% of range)
Temperature coefficient : ± (0.03% of reading + 0.01% of range) /°C
Input impedance : 200 mV - 2 V 20 M // 50 pF
20 V 11 M // 80 pF
200 V - 2000 V 10 M // 90 pF
CMRR :>120 dB for DC signals
> 60 dB for AC signals 50 Hz
Freq. range : 40 Hz ... 100 KHz, incl. or excl. DC component, switchable on front
DC voltage on V for no additional error : 25 x range
Response time : 1.5 s (without ranging)
3 s (with ranging)
AC detector : True RMS
Crest factor : 2 at full scale, increasing down scale via 2 x full scale/reading
Maximum input voltage : Hi and Lo 750 V RMS
Hi and earth 750 V RMS
Lo and earth 250 V RMS
Maximum V - Hz product : 10^7

dB measurements in AC ranges

Possible measuring modes	: AC voltage excl. DC component (V~) AC voltage incl. DC component (V≈)
Range	: - 57.7 + 57.7 dB (reference resistor 600 Ohm) Measured value less than 1 mV is displayed as UL. Measured value > 1000 V is displayed as OL.
0 dB reference	: 1 mW in reference resistor or when selecting the zero function with push-button zero "on/off".
Reference resistor	: programmable between 0.0001 ohm and 9999 ohm.
Resolution	: 0.1 dB
Number of representation units	: 999

Function V~

Accuracy at reference conditions for signals	
- 57.7 dB ... + 47.3 dB	: 40 Hz ... 20 KHz ± 0.2 dB
- 57.7 dB ... - 11.7 dB	20 KHz ... 100 KHz ± 2 dB
- 11.7 dB ... + 47.3 dB	20 KHz ... 100 KHz ± 1 dB
+ 47.3 dB ... + 57.7 dB	: 40 Hz ... 60 Hz ± 0.2 dB

Function V≈

Accuracy at reference conditions	: same as V~ Additional for DC component: ± 0.2 dB
Temperature coefficient	: ± 0.02 dB/°C
Input impedance for signals between	: 0 ... 1.8 V 20 M // 50 pF 1.8 V ... 18 V 11 M // 80 pF > 18 V ... 10 M // 90 pF
CMRR	:>120 dB for DC signals > 60 dB for AC signals 50 Hz ± 1%
Freq. range	: 40 Hz ... 100 KHz, incl. or excl. DC component, switchable on front.
Response time	: 3 s
AC detector	: True RMS
Crest factor	: 2
Maximum input voltage	: Hi and Lo 750 V RMS Hi and earth 750 V RMS Lo and earth 250 V RMS
Maximum V - Hz product	: 10^7

Vpeak

Possible measuring modes	: V peak-peak; Vpeak pos; Vpeak neg
Ranges	: 2 V ... 2000 V (max. input voltage 850 Vpeak)
Resolution	: 1 mV on 2 V range
Number of representation units	: 2100
Accuracy at reference conditions	
dc+ 20 Hz ... 20 KHz	: ± (1% of reading + 0.5% of range) note
20 KHz ... 100 KHz	: ± (5% of reading + 0.5% of range) 1
Temperature coefficient	: ± 0.15% of reading /°C
Input impedance	: 2 V 20 M // 50 pF 20 V 11 M // 80 pF 200 V, 2000 V 10 M // 90 pF
Measuring time	: 500 msec.
DC voltage on Vpeak-peak for no additional error	: 25x range
Response time p+;p-	: 1 sec. (without ranging) 2.5 sec. (with ranging)
p-p	: 1.5 sec. (without ranging) 5 sec. (with ranging)
Max. input voltage	: Hi and Lo 600 V AC or DC 850 Vpeak Hi and earth 600 V AC or DC Lo and earth 250 V AC or DC
Max. V-Hz product	: 10^7
CMRR	:>120 dB for DC signals > 60 dB for AC signals 50 Hz
Note 1	
2000 V range	: freq. range DC + 20 Hz ... 60 Hz

DC current measurements

Ranges	: 1 uA ... 10 A
Resolution	:*High speed mode 1 nA on 1 uA range Normal mode 0.1 nA on 1 uA range
Number of representation units	:*High speed mode: 1100 Normal mode: 11000
Accuracy	: ± (0.1% of reading + 0.05% of range)
Temperature coefficient	: ± (0.01% of reading + 0.005% of range) /°C
Voltage drop at end of range	: ranges 1 uA ... 1 mA < 2.5 mV ranges 10 mA and 1 A < 40 mV ranges 100 mA and 10 A < 400 mV
Response time	: 0.8 s (without ranging) 2.5 s (with ranging)
Protected up to	: 250 V RMS ranges 1 uA - 100 mA. Ranges 1 A ... 10 A not protected
Max. CM - voltage	: 250 V RMS, 350 V peak
Max. input - voltage	: Hi and Lo 250 V RMS Hi and earth 250 V RMS Lo and earth 250 V RMS

AC current measurements

Ranges	: 1 uA ... 10 A
Resolution	:*High speed mode: 1 nA on 1 uA range Normal mode: 0.1 nA on 1 uA range measured value under 1% of range is displayed as 0000
Number of representation units	:*High speed mode : 1100 Normal mode: 11000
Accuracy (valid between 3% and 100% of range)	: ± (0.4% of reading + 0.15% of range)
Temperature coefficient	: ± (0.04% of reading + 0.015% of range) /°C
Freq. range	: 40 Hz ... 200 Hz
Voltage drop	: ranges 1 mA uA ... 1 mA < 2.5 mV ranges 10 mA mA and 1 A < 40 mV ranges 100 mA mA and 10 A < 400 mV
AC detector	: RMS convertor, AC coupled
Crest factor	: 4 at full scale
Response time	: 1.5 s (without ranging) 3 s (with ranging)
Protected up to	: 250 V RMS ranges 1 uA ... 100 mA. Ranges 1 A ... 10 A not protected.
Max. CM Voltage	: 250 V RMS , 350 V peak
Max. input voltage	: Hi and Lo 250 V RMS Hi and earth 250 V RMS Lo and earth 250 V RMS

Resistance measurement

Possible measuring modes	: two-wire configuration selectable via - 0 terminals. with switch four-wire configuration on front via PROBE terminals.
Ranges two-wire	: 200 ohm ... 200 M ohm
Ranges four-wire	: 200 ohm ... 2 M ohm
Maximum lead resistance on four wire configuration	: 2 ohm
Resolution	:*High speed mode: 100 mOhm on 200 Ohm range Normal mode: 10 mOhm on 200 Ohm range
Number of representation units 200 ohm ... 20 M ohm	:*High speed mode: 2100 Normal mode: 21000
200 M ohm	:*High speed mode: 100 Normal mode: 1000
Accuracy 200 ohm - 200 K ohm	: ± (0.1% of reading + 0.05% of range)
2 M ohm - 20 M ohm	: ± (0.5% of reading + 0.1% of range)
200 M	: ± (5% of reading + 1% of range)

Temperature coefficient
200 ohm - 200 K ohm : ± (0.01% of reading + 0.005% of range) /°C
2 M ohm - 20 M ohm : ± (0.05% of reading + 0.01% of range) /°C
200 M : ± (0.5% of reading + 0.1% of range) /°C
Measuring current : 1 mA, 1 mA, 100 uA, 10 uA, 1 uA, 100 nA, 10 nA at the separate ranges
Maximum voltage at open input : 4 V
Polarity of input sockets at two-wire: - on Hi
+ on Lo

Response time
200 ohm - 200 K ohm : 0.8 s (without ranging)
2.5 s (with ranging)
2 M ohm - 20 M : 2 s (without ranging)
3.5 s (with ranging)
200 M ohm : 9 s (without ranging)
10 s (with ranging)
Protected up to : 250 V RMS
Maximum input voltage : Hi and Lo 250 V_{RMS}
Hi and earth 250 V_{RMS}
Lo and earth 250 V_{RMS}

Diode measurements

Driving current : 1 mA
Range : 2000.0 mV
Resolution : 0.1 mV
Number of representation units : 20000
Polarity input sockets : - on Hi
+ on Lo
Response time : 0.8 s
Maximum input voltage : Hi and Lo 250 V_{RMS}
Hi and earth 250 V_{RMS}
Lo and earth 250 V_{RMS}

Continuity

Driving current : 1 mA
Short circuit : Audible tone from 0 ... 10 ohm
Isolation : Resistance > 10 ohm, no tone
Response time : < 0.15 sec.

Capacity measurements

Ranges	: 20 nF ... 2000 uF
Resolution	:*High speed mode: 10 pF in 20 nF range Normal mode: 1 pF in 20 nF range
Number of representation units	:*High speed mode: 2100 Normal mode: 21000 (20 nF .. 200 uF range) 2100 (2000 uF range)
Accuracy:	
20 nF .. 200 uF range	: ± (1% of reading + 0.1% of range)
2000 uF range	: ± (10% or reading + 0.1% of range)
Temperature coefficient:	
20 nF .. 200 uF range	: ± (0.1% of reading + 0.01% of range) /°C
2000 uF range	: ± (1% of reading + 0.1% of range) /°C
Measuring current	: 100 nA, 1 uA, 10 uA, 100 uA, 1 mA at the separate ranges
Maximum voltage at input	: 2.5 V
Polarity input socket	: - on Hi + on Lo
Response time	: 1 s (without ranging) 1.5 s (with ranging)
Protected up to	: 250 V_{RMS}
Maximum input voltage	: Hi and Lo 250 V_{RMS} Hi and earth 250 V_{RMS} Lo and earth 250 V_{RMS}

Temperature measurements

For temperature measurements additional needed	: Pt 100 probe
Range	: - 100 °C ... + 850 °C
Resolution	:*Normal mode: 1°C High resolution mode: 0,1°C
Number of representation units	:*Normal mode: 850 High resolution mode: 8500
Accuracy (excl. probe)	: ± (0.3% of reading + 0.3°C)
Temperature coefficient	: ± (0.03% of reading + 0.003% of range) /°C
Measuring current	: 1 mA
Response time (excl. probe)	: 0.5 s
Linearisation	: probe characteristics is linearised within limits stated in DIN 43760
Max. voltage at probe tip	: depending on probe

Frequency measurements

Ranges	: 10 KHz ... 20 MHz
Resolution	: Normal mode 1 Hz in 10 KHz range High resolution mode 0.1 Hz in 10KHz range
Number of representation units	
10 KHz ... 10 MHz	: Normal mode: 10000 High resolution mode: 100000
20 MHz	: Normal mode: 2000 High resolution: 20000
Accuracy	: $\pm$ (0.01% of reading + 2 digits range)
Temperature coefficient	: $\pm$ 0.001% of reading /^{o}C
Response time	
range 100 KHz ... 20 MHz	: Normal mode 0.3 s (without ranging 0.5 s (with ranging) High resolution 2.5 s (without ranging 3 s (with ranging)
range 10 KHz	: Normal mode 1.5 s (without ranging) 2 s (with ranging) High resolution 13 sec (with ranging)
Impedance	: 10 M // 50 pF
Coupling	: AC
For voltage > 5 V max. V-Hz produkt	: 10^7
Maximum input voltage	: Hi and Lo 250 V_{RMS} Hi and earth 250 V_{RMS} Lo and earth 250 V_{RMS}
Sensitivity	: 10 Hz ... 100 Hz : 1 Vpeak 100 Hz ... 10 MHz : 250 mV peak 10 MHz ... 20 MHz : 500 mV peak

Time measurements

Range	: 1 ... 10^5 seconds
Resolution	: 10 usec in 1 second range
Number of representation units	: 99999
Accuracy for timer measurements	: 0.01% of reading
Hold of time	: 30 usec
Start	: By positive or negative slope passing the trigger level. Selectable by push button "s".
Stop	: By positive or negative slope passing the trigger level. Selectable by push button "s".
Reset	: By pushbutton on date hold probe if connected or stop pulse, if no data hold probe is connected.
Trigger level	: < 1 V

Result representation : Old measurement are displayed at least 500 msec. Display is updated at the "stop-condition" moment. 10 seconds after a "start-condition" the display starts counting the time in seconds untill the "stop condition".
If measuring time > 10 seconds, the beeper will be activated by the "stop-condition" for a moment. A moving baragraph indicated a measurement in progress.

External triggering (/51 and /61 version only)

Response time (single trigger, without ranging):

Function	HSM (speed 3)	NM (speed 2)	HRM (speed 1)	
V_{DC}	0.1	0.4	4	
V_{AC}	0.25	0.55	-	
V_{p+}, V_{p-}	-	0.5	-	
V_{PP}	-	1.0	-	
A_{DC}	0.1	0.4	-	
A_{AC}	0.25	0.55	-	
Ohm	0.1	0.4	-	
Temp.	-	0.5	4.5	
Freq.	-	0.3	1.2	(100 KHz - 20 Mhz range)
Freq.	-	1.5	11	(10 KHz range)
Cont.	0.1	-	-	
Diode	0.1	0.5	-	
Cap.	0.2	0.5	-	

Calculate functions

a. Relative reference setting via push button "zero". Measured value is default reference value (Can be altered manually).
b. Min/max.
   Highest and lowest measured values are stored and can be displayed afterwards.
c. dB
   Display = 20 log $\frac{X}{R}$ X = measured value
   R = reference value
   in function V_{DC}, V_{AC}, $V_{AC + DC}$

Conversion characteristics

Kind of conversion	: lineair
Operating principle	: Delta modulation
Basic mode of operation	: repetitive triggered
Range setting	: Manual- with UP and DOWN pushbutton Automatic-Upranging at 100% of scale 2000/10.000/20.000/100.000/200.000 Down ranging at 9.5% of scale, 190/900/1900/9000/19000
Polarity setting	: Automatic setting on V_{DC}, A_{DC}, Vpeak, ^{o}C, dB, relative reference
Display	
Visual representation	
Number of digits	: $5^{1}/2$, $4^{1}/2$, 4, $3^{1}/2$ depending of function and range
Number of representation units	: 2100 / 11000 / 21000 / 210000 depending of function and range
Means of representation of output value	: liquid crystal display Reflective Additional analog representation function by means of bargraph in LCD
Means of polarity representation	: Automatic indication of + or - or blanked according to measuring function
Means of measuring mode representation	: High speed mode SPEED 3 Normal mode SPEED 2 High resolution mode SPEED 1

Note: SPEED 3 only available on /51 and /61 version for V_{DC}, V_{AC}, Ohm, Cap, A_{DC} and A_{AC} functions.
SPEED 2 for temperature function available only on /51 and /61 version.

Means of decimal point representation	: Automatic indication, depending on range
Means of functional representation	: selected function is indicated in LCD
Means of overload representation	: Display indicates "OL"
Means of representation of exceeding crest factor	: in display
Data hold	: By using data hold probe PM 9267
Range hold	: possible via Auto/Man switch

Operating conditions (according to IEC 359)

a. Climatic conditions	: Group I with extension of the temperature limits
Temperature :	
Reference temperature	: + 23°C ± 1°C
Rated range of use	: 0°C ... ± 40°C
Adjustment temp. range	: + 21°C ... +25°C (factory only)
Limit range of operation	: 0°C ... +55°C
Limit range of storage and transport	: -40°C ... +70°C
Humidity :	
Reference rel. hum.	: 20 ... 80% excluding condensation
Limit range of storage and transport	: 5 - 95% RH
Max. dew point	: 26°C
b. Mechanical conditions	: according UN-D 1639/03 class: portable equipment subclass I
c. EMC	
Emmision	: CISPR publ. 11 and 14 VDE 871-B, VDE 875-K according Vfg 1046/84

Line supply conditions

Group	: S2
Reference value	: 230 V ± 1%
Rated range of use	: 230 V ± 12% - 15%
Note	: Instrument can be altered for nominal mains voltages of 115V

Mains supply frequency

Reference value	: 50 Hz ± 1%
Rated range of use	: 50 Hz ± 5%
Note 1	: Instrument can be altered for nominal mains frequency of 60 Hz.
Note 2	: Mains frequency can influence Series Mode Rejection; see specification SMR. To meet same spec. for 60 Hz as for 50 Hz signals, the settings of the PM 2525 must be altered in the check function.

Mains supply interruptions

Interruption	< 30 ms	: no influence
	> 30 < 500 ms	: instrument may either restart or continue
	> 500 ms	: instrument will restart, conditions equals situation after switching on power.

Power consumption : 12 VA

Calibration

Recalibration interval : 1 year

Accessories

Supplied with instrument : Measuring leads PM 9266 (incl. probes)
Mains supply cable
Spare fuses
Operation manual

Optional available :

Specific accessories for PM 2525	: 4 wire Ohm cable	5322 321 20506
	: 4 wire Ohm cable	PM 9264/01
Universal accessories	: high frequency probe	PM 9210
	Shunt	PM 9244
	Current transformer	PM 9245
	EHT probe	PM 9246
	Temp. probe (PT100)	PM 9249/01
	Data hold probe	PM 9267/01
	Current gun	PM 9101
	Current probe	PM 9102
	HF probe	PM 9213
	Measuring leads	PM 9260
	Measuring leads	PM 9266
	Thermo coupler linearizer	PM 9877/J
	Thermo coupler linearizer	PM 9877/K
	19 inch rackmount	PM 2193

Miscellaneous

Dimensions	: (LxBxH) 287x210x86 (excl. feet) 287x210x106 (incl. feet)
Weight	: 2.5 kg 3.5 kg /21, /51, /61 and /71 version
Cabinet	: BAYBLEND KL1441 /51, /61 and /71 version: steel back plate

Safety

Class 2, according IEC 348

3. CIRCUIT DESCRIPTION

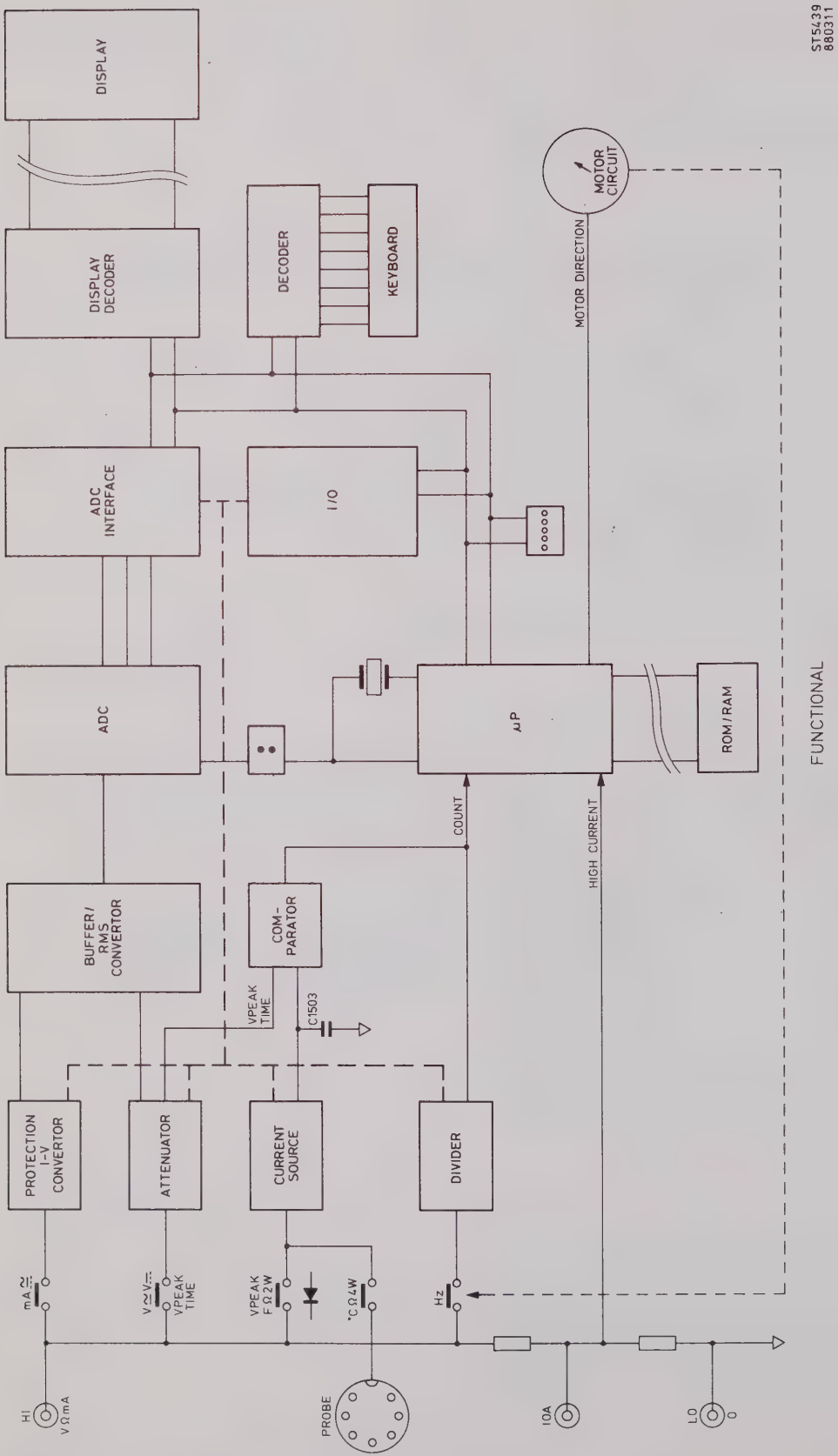
SHORT DESCRIPTION OF THE PM2525

1. General

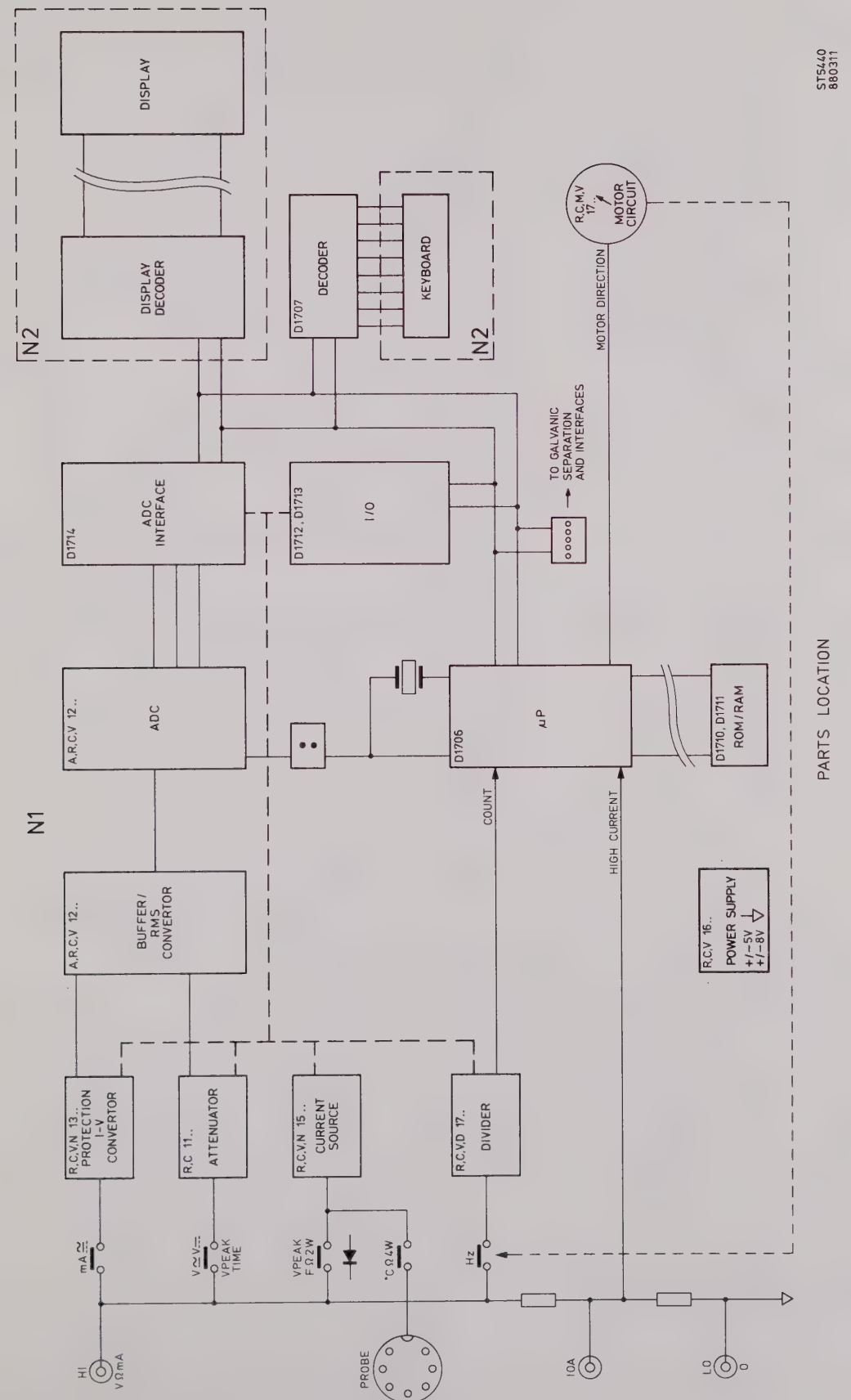
The PM2525 a multimeter ment as successor for the PM2521.
The specification has been extended on the following points:
1. Basic accuracy for DC from 0.03% to 0.02%
2. Resolution for DC from 10 uV to 1 uV.
3. AC voltage function DC coupled.
4. A peak-voltage function up to 2000 digits, 1mV resolution.
5. Four-wire resistance measurements.
6. Highest resistance range from 20 Mohm to 200 Mohm.
7. In the diode function a bleeper signal; response time <100 ms.
8. Capacity measurements from 1 pF to 2000 uF.
9. Frequency measurements from 10 MHz to 20 MHz, AC coupled.
10. To be extended as system multimeter (IEEE-488, RS232C).
11. Fully programmable (also function).
12. Min/Max function.
13. dBm for VDC.
14. Reference level programmable on front.
15. Operator friendly front with small pushbutton switches.

2. Mechanical construction

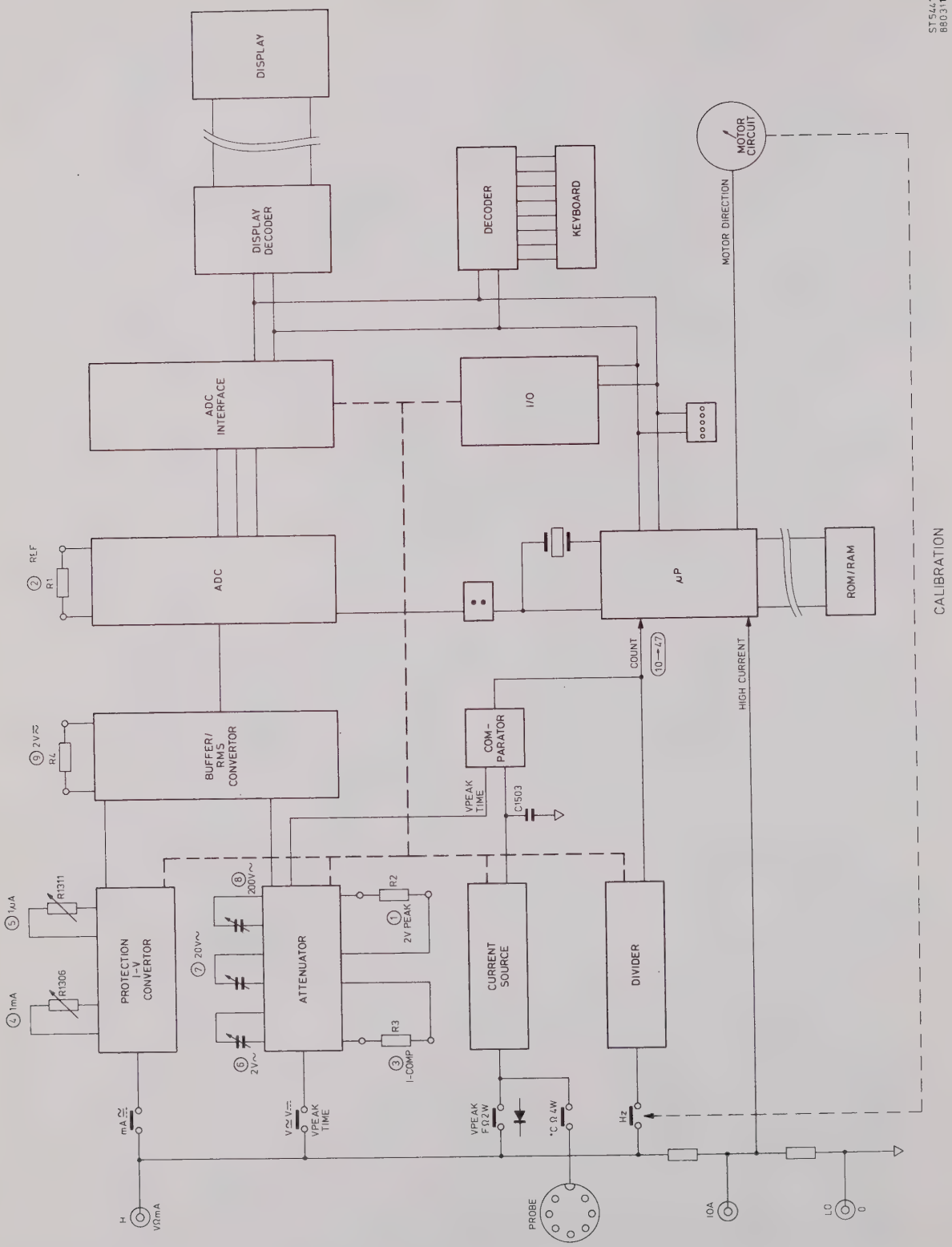
Housing of synthetic material contructed in the same way as the PM2521.
Front composition in the same way as the PM2535.
Internal built-up: One mother board and a front-display board.
In the mother board a motor controlled function switch has been incorperated.
The power supply transformer is mounted on the motherboard.
In the topcover the interfaces can be mounted.
On the front-display board the pushbutton-switches, the IC for reading the switches and LCD and LCD-driver are mounted.



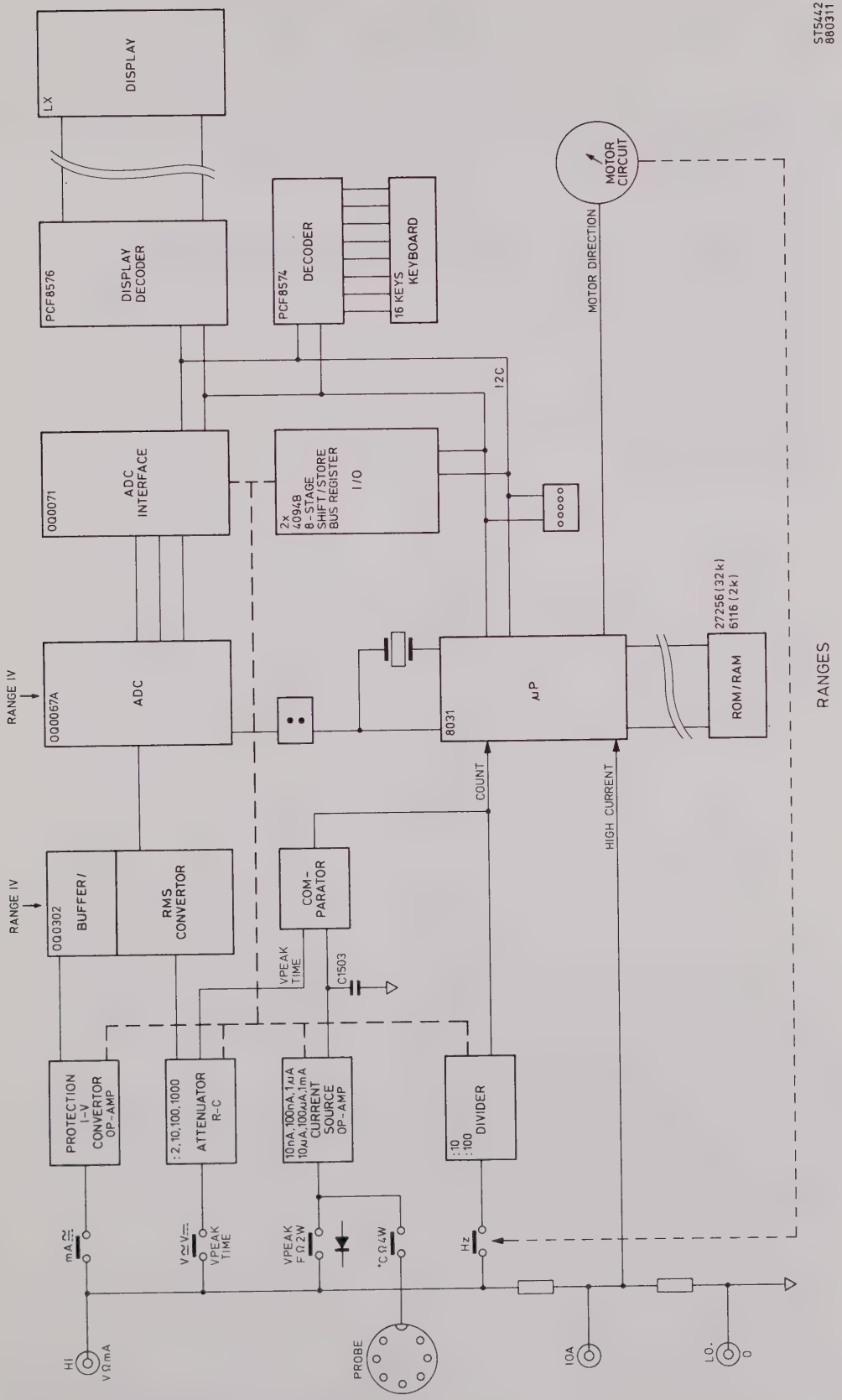
Block diagram PM2525, functional



Block diagram PM2525, parts location



Block diagram PM2525, calibration



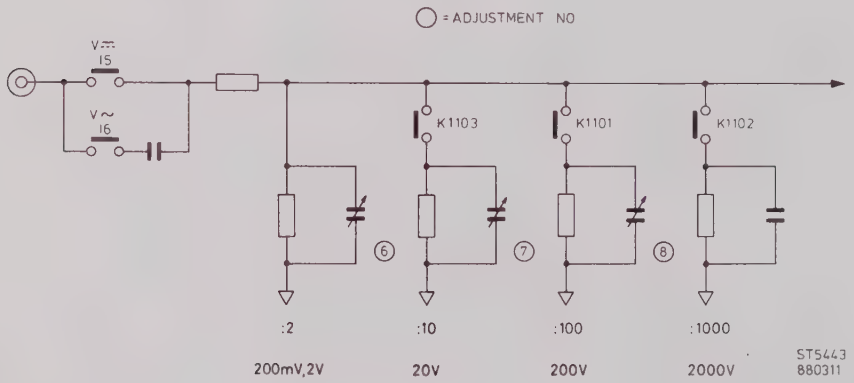
Block diagram PM2525, ranges

3. Electrical construction

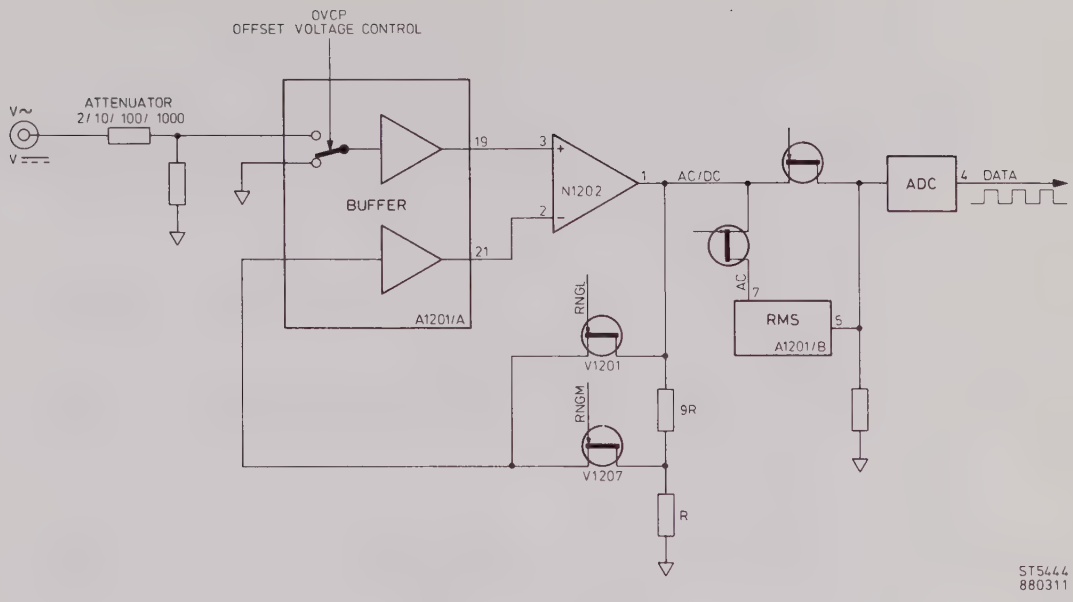
The PM2525 can be subdivided in the following parts:

a. Attenuator and voltage measurements
b. Pre-amplifier
c. Current measurement
d. RMS convertor
e. ADC
f. Peak-voltage measurement
g. Current source for resistance measurements, temperature measurements, capacity measurements, peak-voltage measurements
h. Resistance measurments
i. Temperature measurements
j. Capacity measurements
k. Frequency measurments
l. Time measurements
m. Digital control and computing
n. Power supply
o. Function-switching
p. Internal temperature measurement

3a. Attenuator



A combined frequency compensated atenuator for AC and DC is used. It is built-up of metalglass and metalfilm resistors. These resistors have the same temperuture coefficient. To compensate the rest of temperature coefficient from the attenuator + pre-amplifier + ADC, an extra temperature compensation has been used.
For this reason the internal temperature of the PM2525 is measured.(transistor V1500). The temperature coefficient of the PM2525 has to be determined by a measurement at room temperature and an additional measurement at a higher temperature (over 40 deg C)
The temperature coefficient determined, is used by the micro-processor to make calculations on the ADC data.



3B. Pre-amplifier

The characteristics of the PM2525 are mainly determined by the pre-amplifier. A resolution of 10 uV resp. 1 uV (high resolution mode) for DC and 100 kHz for AC, ask for an amplifier with Auto Zero Compensation (AZC) for DC and a bandwidth equal to or better than a LF356.
A secial IC (OQ0302) has been designed for this purpose. (Refer 3d. RMS conv.)

3c. Current measurements

The current measurements can be subdivided in three parts:

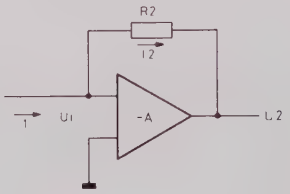
1. The low currents 1 uA to 1 mA are measured via the compensation method in two regions viz. 1 uA - 10 uA and 100 uA - 1 mA with a voltage resolution of the pre-amplifier of 10 uV and 100 uV

2. The medium currents 10 mA and 100 mA.
   Current to voltage conversion by means of a shunt of 2 ohm and fused. Voltage resolution of the pre-amplifier 2 uV resp. 20 uV.

2. The high currents 1 A and 10 A.
   Current to voltage conversion with a 20 mohm shunt and not fused. Voltage resolution of the pre-amplifier 2 uV resp. 20 uV.

Circuit element principles:

I to V convertor - This is effectively a shunt feedback amplifier based around the operational amplifier N1301. The principle is as follows:



ST3362
820503

Basic I-V convertor

The amplifier has a gain of -A (180° phase-shift) and a high input impedance.

If we assume that $U_i = \frac{U2}{A} \simeq 0$ (virtual earth point) and the input signal to be a current I_1 which is equal to 12, then the output signal will be a voltage

$$-U2 = I1 \times R2$$

In other words, the amplification is given by the resistor value of R2.

In the practical application, it means that the input currents from the shunts are converted into output voltages, the magnitude also being dependent on the values of the selected feedback resistors.

3d. PRODUCT DESCRIPTION OQ0302 (A1201)

The OQ0302 converts the RMS value of a signal into a DC value.
The circuit is split-up into two parts: the input-buffer-amplifier and the RMS-DC convertor. The offset voltage of both parts is eliminated automatically by the auto-zero-circuit. The buffer amplifier consists of four source followers to which an external dual-opamp has to be connected.

PINNING

1	VNG (-8V)	negative supply	
2	CR	crest-factor indication	
3	SWD	switch disable input	
4	CAV	averaging capacitor	
5	OUTR	output RMS-convertor	
6	NUL	analog zero	
7	INR	RMS-convertor input	
8	RCA	conversion resistor	
9	CZ1	auto-zero capacitor 1	
10	CZ2	auto-zero capacitor 2	
11	RCB	conversion resistor	
12	GND	zero	
13	IN4	input source follower	1
14	IN1A	"	2
15	IN3	"	3
16	IN1B	"	1
17	OUT3	output souce follower	3
18	OUT4	"	4
19	OUT1	"	1
20	IN2	input source folower	2
21	OUT2	output sorce follower	2
22	OVCP	zero volt pre-amplifier	
23	OVCR	auto-zero input RMS-convertor	
24	VPL (+8V)	positive supply	

THE RMS-CONVERTOR

The convertor is built-up of a voltage-current convertor, followed by a rectifier and a RMS to DC circuit.
Input-offset voltage drift is minimized by the auto-zero cicuit. The offset current-drift of the output-circuit, that is not included in the auto-zero, is of non importance.

The maximum input signal will have a RMS value of 1 Volt. A crest-factor of two may not be exceeded. The signal is allowed to have a AC as well as a DC component and is connected to inputs INR and NUL.

The conversion resistor should be about 10 kohm to get a optimum crest-factor indcation.

During the auto-zero phase the input signal is switched-off and the input of the V/I-convertor is connected to zero. The SWD input must be low (GND). When the SWD input is high (open) the input signal is connected to the V-I convertor. The SWD input has an internal pull-down circuit. The offset-voltage of the pre-amplifier can be eliminated in this way if during the auto-zero phase the input of the pre-amplifier is connected to zero.
The auto-zero phase will last about 10 mili-seconds, dependent on the drift to be eliminated. During this phase the pre-amplifier has to consume of 10uA.

Every part of the symmetrical V-I convertor has a own auto-zero capacitor. The voltage over these capacitors will be nominally 0 Volt.

To realise a large frequency range, the rectifier is set to class ab. By this the rest-current in the output will cause a voltage drop of 3 mV over a 5 kohm resistor. Voltages lower than 5 mV must be displayed as zero.

The RMS value of AC and DC is determined in an analog way. In the output signal an error will occur in the shape of an average (or DC) value of a ripple. The DC error is dependent on the frequency of the signal and the value of the averaging capacitor CAV.

During the auto-zero phase the averaging capacitor CAV is discharged, but not internally disconnected. During the measuring phase this capacitor has to be charged again by the input signal. Therefore it is not possible to start a ADC-cycle immediatly after the auto-zero phase to determine the measured value. A wait-time of about 3-times the auto-zero time is needed. This wait-time can be avoided if in series with CAV a FET is switched. This FET can be controlled by signal OVCR, if the levels ly between GND and the negative supply. CAV is switched-off during the auto-zero phase.

The auto-zero input OVCR has an internal pull-down circuit by which the convertor is switched to the auto-zero position (logic 1, negative logic). If OVCR is connected to logic zero the convertor is switched in its measuring position. The input current of the auto-zero circuit is limited by an internal resistor. By the internal pull-down circuit a current of 25 uA wil flow. The switching point is at -2.5 V.

The crest-factor indication is set if the input signal is to large. The latch circuit is automatically reset by the OVCR signal.The crest-factor indication output is a open collector output to the negative supply.

The supply voltage is nominally +8 and -8 VOLT. The maximum switching is directly dependent to the negative supply voltage.

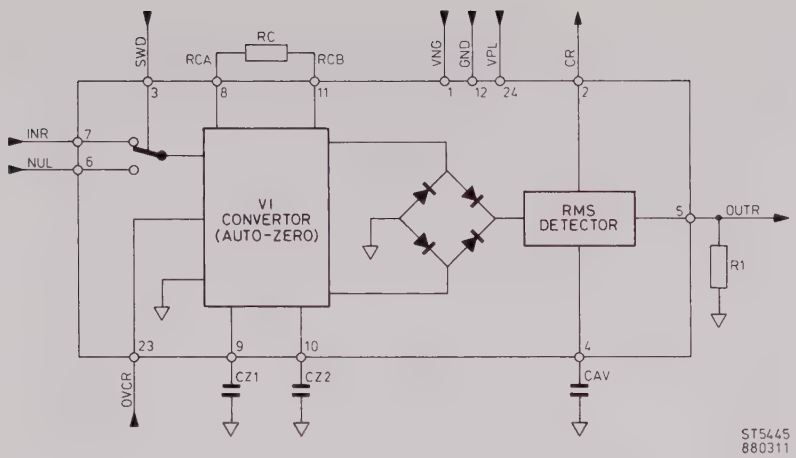
THE PRE-AMPLIFIER/BUFFER

The pre-amplifier consists of four source-followers with a high input-resistance and a low bais current. To the output of the source-followers a dual op-amp has to be connected. Advised is to a NE5532. In series with input 1 of follower 1, two series switches are incorperated, of which input 1B is used as zero input. The offset-voltage of the pre-amplifier is not adjusted, but stands in series with input-offset voltage of the convertor, if input SWD is logic 1.If not, the offset-voltage drift of the pre-amplifier has to be compensated digitally. In this case a measurement has to be made with input INB to zero.

The buffer amplifier built-up around the source followers 3 and 4 takes care of the AC-path. In this way the input-signal is not attenuated by the low-pass filter (R=590 kohm in series with the input and capacitor C=10 nF in parallel with the output of the AC path). This RC-filter at the input is necessary to realise a minimum of feedback on the input (kick-back).

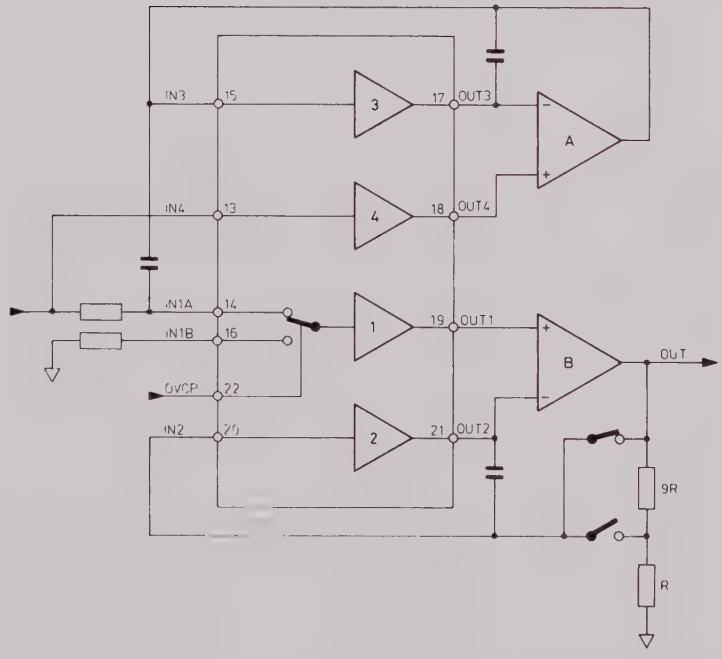
Input IN4 has been suplied with a protection circuit. If the input voltage is higher than 5 Vpp the input resistance drops and the current carried-off via the ground connection.

The zero input of pre-amplifier OVCP function identically to the auto-zero input of the convertor part.



ST5445
880311

RMS-DC convertor
(OQ0302)



ST5446
880311

Buffer pre-amplifier
(OQ0302)

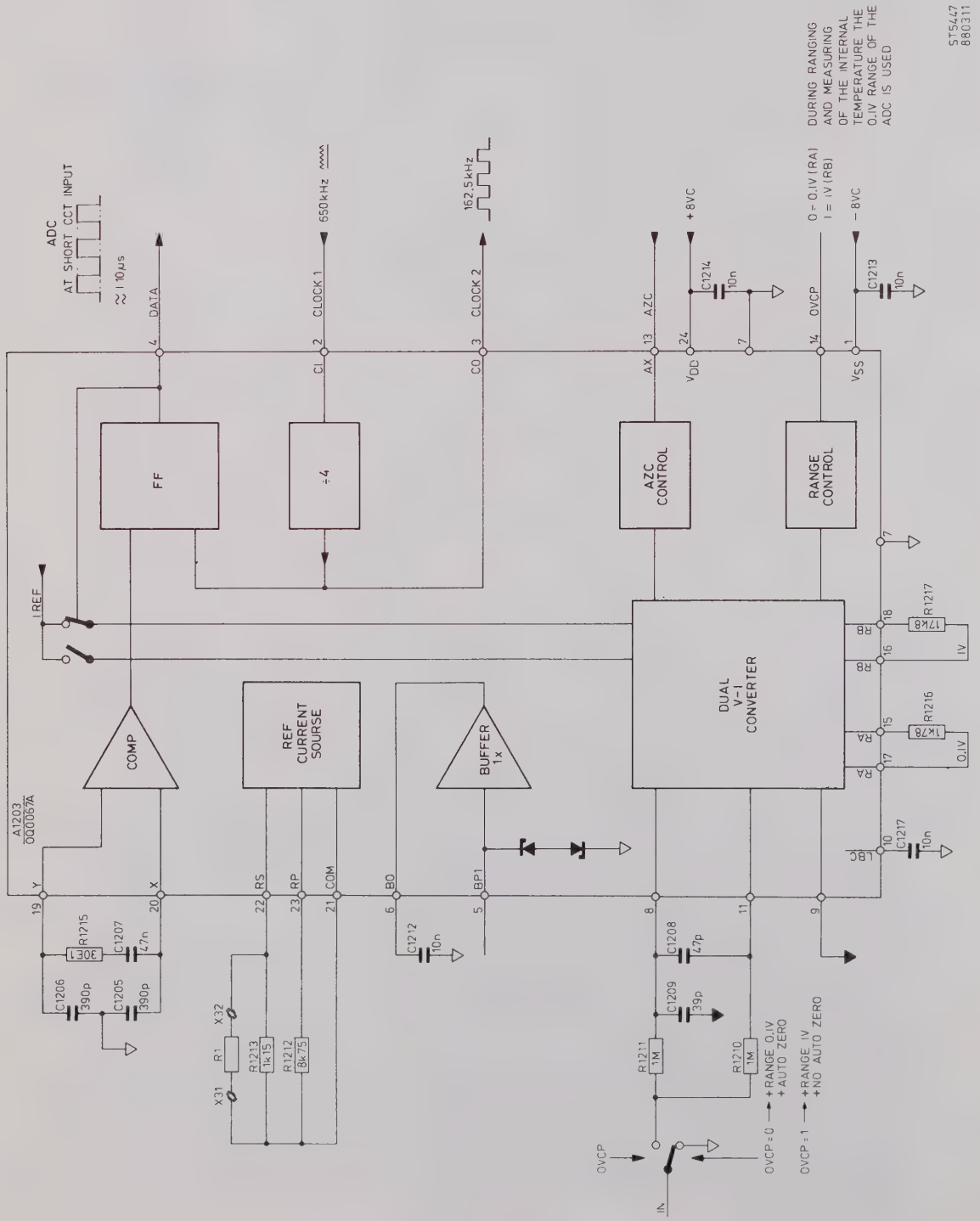
3e. Analog-to-digital converter ADC OQ0067A A1203

The ADC converts the analog signal into a digital signal by the delta modulation principle. Basically, the delta modulation ADC counts the difference in the time taken to charge and to discharge a capacitor about a fixed level, over a fixed period of time.
The number of charge/discharge cycles within this fixed time depends on the charge/discharge current which is made proportional to the unknown input voltage to the ADC. Therefore, the number of pulses counted within a fixed measuring period is proportional to the unknown voltage Vx. The obtained data signal is fed to the ADC interface D1714 where it is counted.

To obtain automatic zero i.e. counteract drift and internal offset, one complete measurement consist of two fixed measuring periods (two AZC periods).
One complete measurement is used to update the bargraph or for automatic ranging. However, a display result consist of two complete measurements.

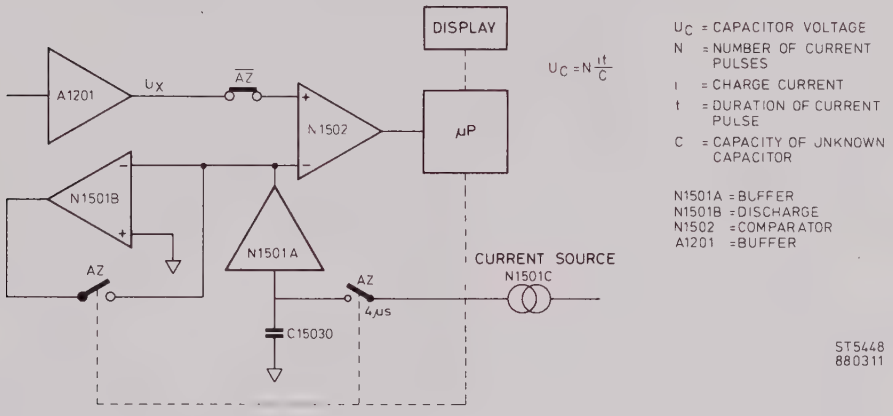
During the first period of a measurement the AZC input is low and the ADC interface counts up on each clock-edge the logical state of the data signal. The value is kept in a register. During the second period, the data signal is inverted by the ADC interface and on each clock-edge the logical state of the input signal, the register is counted down. Also the input of the ADC is inverted so that offset in the result is compensated.

The ADC has two input sensitivites 90 mV and 900 mV, selected by the signal OVCP. This signal selects either R1217 or R1216 as conversion resistor.



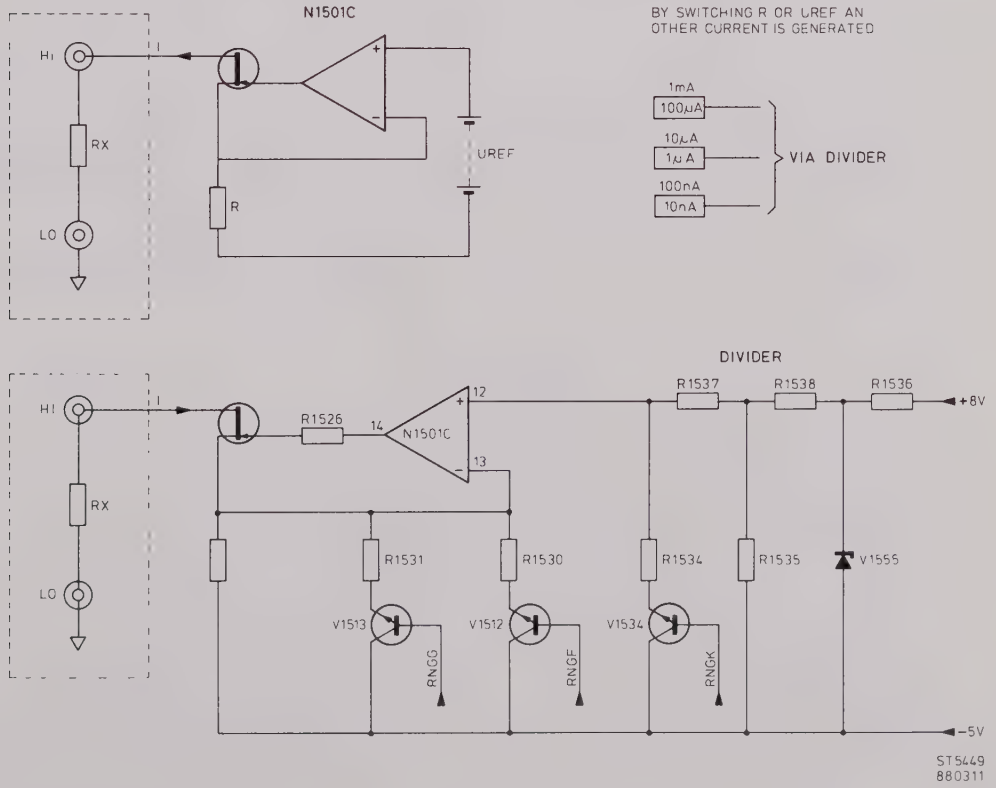
3f. Peak-voltage detector

Principle:
The unknown peak-voltage is compared by means of a comparator with a voltage in a capacitor. If Upeak > Uc then the capacitor is charged in steps.
The number of steps is counted and equals the voltage on the capacitor.



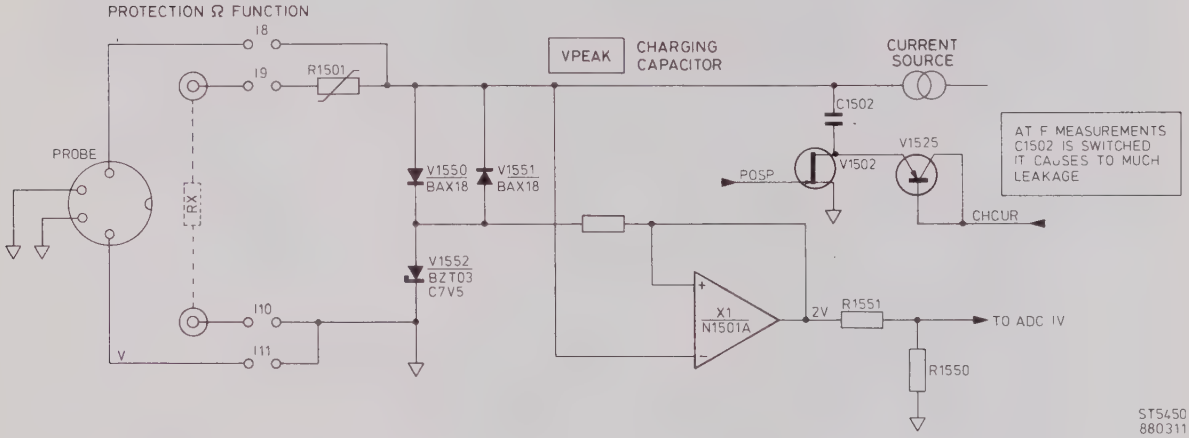
3g. Current source for resistance like measurements.

Principle:
The voltage over a resistor is made equal to a reference voltage by an operational amplifier. The current needed will be constant and is the same current as needed for the current source.



3h. Resistance measurements RTW RFW ^{o}C

The current from the current-source is supplied through Rx.
The voltage drop is measured by the ADC.



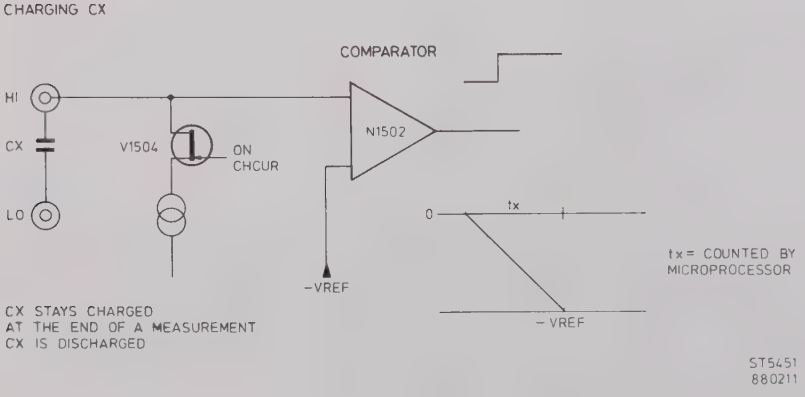
3i. Temperature measurements (refer to 3h.)

Principle:
4-wire resistance measurements on a Pt100 element (e.g. PM9249)
The micro-processor compensates the zero degrees (100 ohm). The micro-processor also carries out the wanted accuracy and linearity calculations.

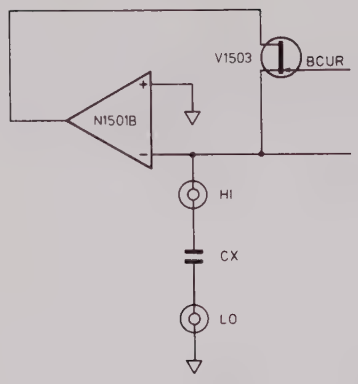
3j. Capacity measurements

Princple:
Through the unknown capacitor a constant current is fed: $Cx = \frac{iT}{Ucx}$

The voltage over the capacitor is compared with a reference current.
The time needed to charge the capacitor to the level of Uref., is measured by the micro-processor. It is related to the capacitance.
The reference voltage is generated by the constant-current i, fed through a known resistor.
The voltage over R is stored in the auto-zero capacitor of the pre-amplfier.



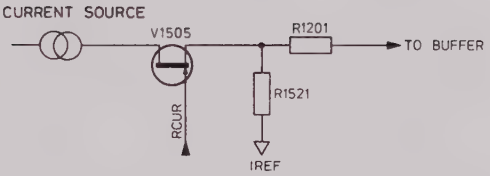
DISCHARGING CX



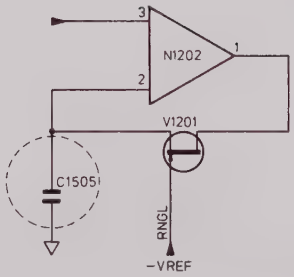
ST5452
880211

-VREF

CURRENT SOURCE



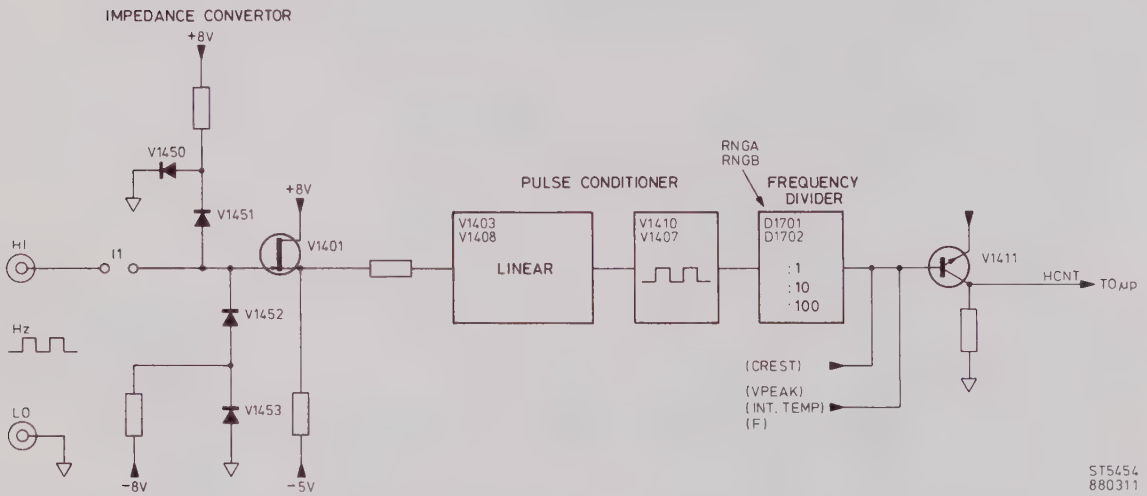
DURING DISCHARGING OF CX AT THE END OF A MEASUREMENT V R1521 IS CHARGED IN CAPACITOR C1505



ST5453
880211

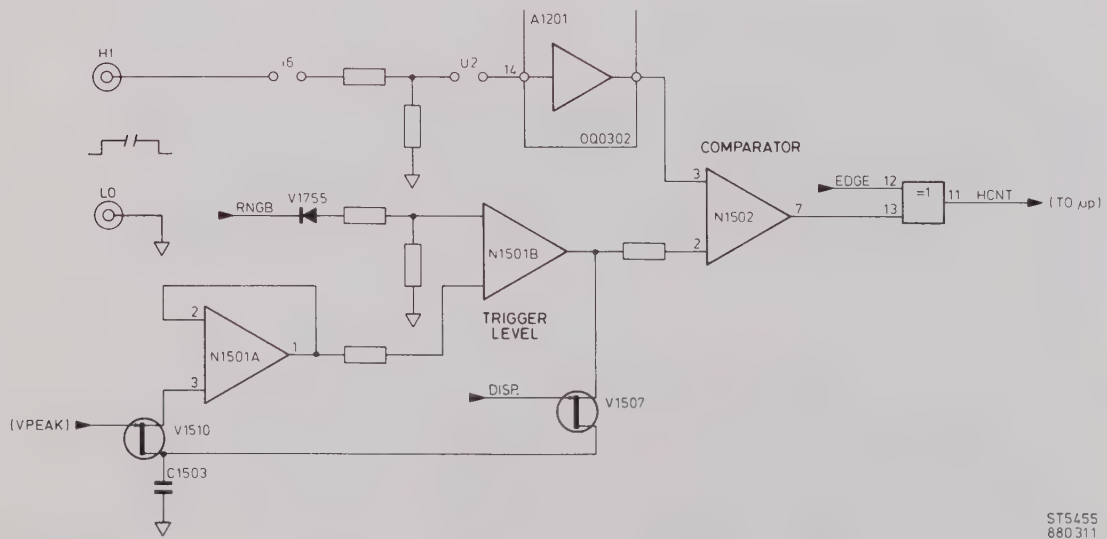
3k. Frequency measurements

Principle:
The incoming signal is amplified and set to a correct level with two invertors. It is supplied to a hardware circuit that attenuates 1, 100, 1000 dependent on the measuring range. The signal is processed by the internal counter of the micro-computer.



31. Time measurements

In the time measurements function the signal may be inverted or directly supplied to the internal timer of the micro-processor. The inversion of the signal enables starting on respectively stopping on a positive or negative level.



3m. Digital control and computing

The heart is a 8031 micro computer with a ROM and RAM
Links to the analog section are made via an OQ0071 and two 8-stage shift registers.

SWITCHING TABLE (1-2)

	DSHF00									DSHF01									OQ071									P4		
	SHIFT-REGISTERS																													
	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0		0	5	4
	OVCR	DISP	TMPM	STOP	THLD	RNGC	RNGE	RNGD		FCAP	RNGB	FPEAK	RNGF	RNGA	RNGG	MDIR	RNGK		ACDC	OVCP	POSP	NEGP	RNGM	RNGL	CHCHR	RCUR		BEDGE	BCUR	CRST
V^																											(inv)			
2V	0	0*	0	1	0	0	0	0	10	0	1	1	1	1*	0	1	0	7A	1	1	1*	1	1	0	0	0	07	0	1*	0*
20V	0	0*	0	1	0	1	0	0	14	0	1	1	1	1*	0	1	0	7A	1	1	1*	1	1	0	0	0	07	0	1*	0*
200V	0	0*	0	1	0	0	0	1	11	0	1	1	1	1*	0	1	0	7A	1	1	1*	1	1	0	0	0	07	0	1*	0*
2000V	0	0*	0	1	0	0	1	0	12	0	1	1	1	1*	0	1	0	7A	1	1	1*	1	1	0	0	0	07	0	1*	0*
Vv																														
2V	0	0*	0	1	0	0	0	0	10	0	1	1	1	1*	0	1	0	7A	1	1	1	1*	1	0	0	0	07	0	1*	0*
20V	0	0*	0	1	0	1	0	0	14	0	1	1	1	1*	0	1	0	7A	1	1	1	1*	1	0	0	0	07	0	1*	0*
200V	0	0*	0	1	0	0	0	1	11	0	1	1	1	1*	0	1	0	7A	1	1	1	1*	1	0	0	0	07	0	1*	0*
2000V	0	0*	0	1	0	0	1	0	12	0	1	1	1	1*	0	1	0	7A	1	1	1	1*	1	0	0	0	07	0	1*	0*
V ⎓																														
200mV	0	1	1	1	0	0	0	0	70	0	1	1	0	0	0	1	0	62	0	1	1	1	0	1	0	0	8B	1	1	0
2V	0	1	1	1	0	0	0	0	70	0	1	1	0	0	0	1	0	62	0	1	1	1	1	0	0	0	87	1	1	0
20V	0	1	1	1	1	1	0	0	7C	0	1	1	0	0	0	1	0	62	0	1	1	1	1	0	0	0	87	1	1	0
200V	0	1	1	1	1	0	0	1	79	0	1	1	0	0	0	1	0	62	0	1	1	1	1	0	0	0	87	1	1	0
2000V	0	1	1	1	1	0	1	0	7A	0	1	1	0	0	0	1	0	62	0	1	1	1	1	0	0	0	87	1	1	0
V ~																														
200mV	1*	1	1	1	0	0	0	0	F0	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	0	1	0	0	0B	1	1	0
2V	1*	1	1	1	0	0	0	0	F0	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
20V	1*	1	1	1	1	1	0	0	FC	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
200V	1*	1	1	1	1	0	0	1	F9	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
2000V	1*	1	1	1	1	0	1	0	FA	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
V ⎓																														
200mV	1*	1	1	1	0	0	0	0	F0	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	0	1	0	0	0B	1	1	0
2V	1*	1	1	1	0	0	0	0	F0	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
20V	1*	1	1	1	1	1	0	0	FC	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
200V	1*	1	1	1	1	0	0	1	F9	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
2000V	1*	1	1	1	1	0	1	0	FA	0	1	1	0	1*	0	1	0	6A	1	1*	1	1	1	0	0	0	07	1	1	0
Ω 2W																														
200Ω	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	0	50	0	1	0	1	0	1	1	0	A9	1	0	0
2kΩ	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	0	50	0	1	0	1	1	0	1	0	A5	1	0	0
20kΩ	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	1	51	0	1	0	1	1	0	1	0	A5	1	0	0
200kΩ	0	0	0	1	1	0	0	0	18	0	1	0	0	0	1	0	0	44	0	1	0	1	1	0	1	0	A5	1	0	0
2MΩ	0	0	0	1	1	0	0	0	18	0	1	0	0	0	1	0	1	45	0	1	0	1	1	0	1	0	A5	1	0	0
Ω 4W																														
200Ω	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	0	50	0	1	0	1	0	1	1	0	A9	1	0	0
2kΩ	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	0	50	0	1	0	1	1	0	1	0	A5	1	0	0
20kΩ	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	1	51	0	1	0	1	1	0	1	0	A5	1	0	0
200kΩ	0	0	0	1	1	0	0	0	18	0	1	0	0	0	1	0	0	44	0	1	0	1	1	0	1	0	A5	1	0	0
2MΩ	0	0	0	1	1	0	0	0	18	0	1	0	0	0	1	0	1	45	0	1	0	1	1	0	1	0	A5	1	0	0
20MΩ	0	0	0	1	1	0	0	0	18	0	1	0	0	0	0	0	0	40	0	1	0	1	1	0	1	0	A5	1	0	0
200MΩ	0	0	0	1	1	0	0	0	18	0	1	0	0	0	0	0	1	41	0	1	0	1	1	0	1	0	A5	1	0	0

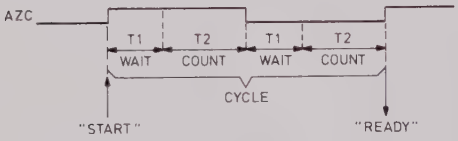
SWITCHING TABLE (2-2)

	DSHF00									DSHF01									OQ071									P1		
	SHIFT-REGISTERS																												
	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0		0	5	4
	OVCR	DISP	IMPM	STOP	THLD	RNGC	RNGE	RNGD		FCAP	RNGB	FPEAK	RNGF	RNGA	RNGG	MDIR	RNGK		ACDC	OVCP	POSP	NEGP	RNGM	RNGL	CHCHR	RCUR		BEDGE	BCUR	CRST
A ⎓																											(inv)			
1uA	0	1	1	1	1	0	0	0	78	0	1	1	1	0	0	1	0	72	0	1	1	1	0	1	0	0	8B	1	1	0
10uA	0	1	1	1	1	0	0	0	78	0	1	1	1	0	0	1	0	72	0	1	1	1	1	0	0	0	87	1	1	0
100uA	0	1	1	1	1	1	0	0	7C	0	1	1	1	0	0	1	0	72	0	1	1	1	0	1	0	0	8B	1	1	0
1mA	0	1	1	1	1	1	0	0	7C	0	1	1	1	0	0	1	0	72	0	1	1	1	1	0	0	0	87	1	1	0
10mA	0	1	1	1	1	0	0	0	78	0	1	1	1	0	0	1	0	72	0	1	1	1	0	1	0	0	8B	1	1	0
100mA	0	1	1	1	1	0	0	0	78	0	1	1	1	0	0	1	0	72	0	1	1	1	1	0	0	0	87	1	1	0
1A	0	1	1	1	1	0	0	0	(78)	0	1	1	1	0	0	1	0	72	0	1	1	1	0	1	0	0	8B	1	1	0
10A	0	1	1	1	1	0	0	0	(78)	0	1	1	1	0	0	1	0	72	0	1	1	1	1	0	0	0	87	1	1	0
A ~																														
1uA	1*	1	1	1	1	0	0	0	F8	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	0	1	0	0	0B	1	1	0
10uA	1*	1	1	1	1	0	0	0	F8	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	1	0	0	0	07	1	1	0
100uA	1*	1	1	1	1	1	0	0	FC	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	0	1	0	0	0B	1	1	0
1mA	1*	1	1	1	1	1	0	0	FC	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	1	0	0	0	07	1	1	0
10mA	1*	1	1	1	1	0	0	0	F8	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	0	1	0	0	0B	1	1	0
100mA	1*	1	1	1	1	0	0	0	F8	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	1	0	0	0	07	1	1	0
1A	1*	1	1	1	1	0	0	0	(F8)	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	0	1	0	0	0B	1	1	0
10A	1*	1	1	1	1	0	0	0	(F8)	0	1	1	1	1*	0	1	0	7A	1	1*	1	1	1	0	0	0	07	1	1	0
										1 ms high																				
S																														
all	0	1	0	1	1	0	0	0	58	0	1*	1	0	1*	0	0	01	09	1	1	0	1	1	0	0	0	27	0*	1	0
										1 ms high																				
F																														
20nF	0	0	0	1	1	0	1	1	1B	1	1	0	0*	1*	0*	0	0*	C8	0	1*	1	0	1	1*	0*	0*	93	0	1*	0
200nF	0	0	0	1	1	0	1	1	1B	1	1	0	0*	1*	1*	0	1*	CD	0	1*	1	0	1	1*	0*	0*	93	0	1*	0
2uF	0	0	0	1	1	0	1	1	1B	1	1	0	0*	1*	1*	0	0*	CC	0	1*	1	0	1	1*	0*	0*	93	0	1*	0
20uF	0	0	0	1	1	0	1	1	1B	1	1	0	1*	1*	0*	0	1*	D9	0	1*	1	0	1	1*	0*	0*	93	0	1*	0
200uF/	0	0	0	1	1	0	1	1	1B	1	1	0	1*	1*	0*	0	0*	D8	0	1*	1	0	1	1*	0*	0*	93	0	1*	0
2000uF	For speed 3, shift one range									Range 200uF and 2000uF will be deleted.									Range 20nF will become settings of range 200nF etc.											
Hz																														
10kHz	0	1	1	1	0	1	0	0	74	0	1	1	0	1	0	0	1	69	1	0	1	1	1	0	0	0	47	1	1	0
100kHz	0	1	1	1	0	1	0	0	74	0	1	1	0	1	0	0	1	69	1	0	1	1	1	0	0	0	47	1	1	0
1MHz	0	1	1	1	0	1	0	0	74	0	1	1	0	0	0	0	1	61	1	0	1	1	1	0	0	0	47	1	1	0
10MHz	0	1	1	1	0	1	0	0	74	0	0	1	0	0	0	0	1	21	1	0	1	1	1	0	0	0	47	1	1	0
20MHz	0	1	1	1	0	1	0	0	74	0	0	1	0	0	0	0	1	21	1	0	1	1	1	0	0	0	47	1	1	0
°C																														
2kΩ-4W	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	0	50	0	1	0	1	1	0	1	0	A5	1	0	0
⊣⊢																														
2kΩ-2W	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	0	50	0	1	0	1	1	0	1	0	A5	1	0	0
🔊																														
200Ω-2W	0	0	0	1	1	0	0	0	18	0	1	0	1	0	0	0	0	50	0	1	0	1	0	1	1	0	A9	1	0	0
										remains in the same position																				
int.tmp.																														
	0	0*	1	1	0	a	a	a	3B	0	1	1	1	1*	0	1	0	7A	1	0	1	1*	a	a	0	0	4F	0	1*	0*
null 200mV																														
	a	a	1	1	0	a	x	x		0	a	a	a	a	a	a	a		0	0	1	1	1	0	a	0		a	a	a
null 20V																														
	a	a	1	1	1	a	x	x		0	a	a	a	a	a	a	a		0	0	1	1	1	0	a	0		a	a	a
	remains in same position except in function F.																													

ADC interface OQ0071 D1714

The information transport to this device is by means of an I^2C compatible interface.
This ADC interface is activated by a start condition so that it first reads an eight bit address. The four most-significant bits contain the group address, and the four least-significant bits contain a command to be executed by the device. This is in contradiction to the I^2C specification where these bytes are reserved for the device address.

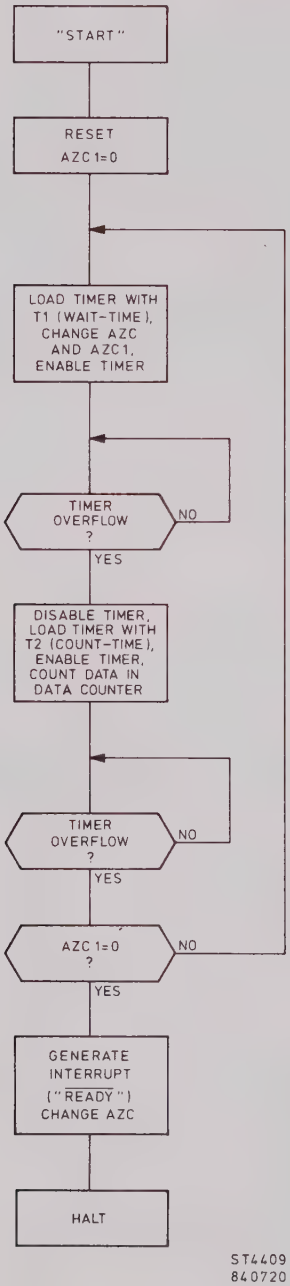
The main purpose of the ADC interface is to count the number of clock-pulses within a given time period (T2, the measuring time) in which the data input is opposite to the AZC signal has been inverted. The time periods are preceded by a waiting time T1 (setting time). The figure below explains this sequence.

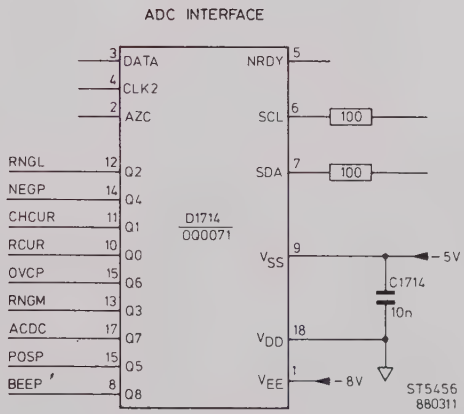


ST4408
840720

At the end of this cycle the device generates a ready (READY) which interrupts the microcomputer.
It instructs the microcomputer to read the internal counter of the ADC interface.
The organisation should be such that when data continuously high and the number in T2 is N, that at the end of the count-time the contents of the counter are also N.

Flow-chart of the sequence:





Besides these functions, the ADC interface has eight output latches to control to analog section (input sensitivities) .One of the latches is used to give an a.c. signal which is used for the bleeper.

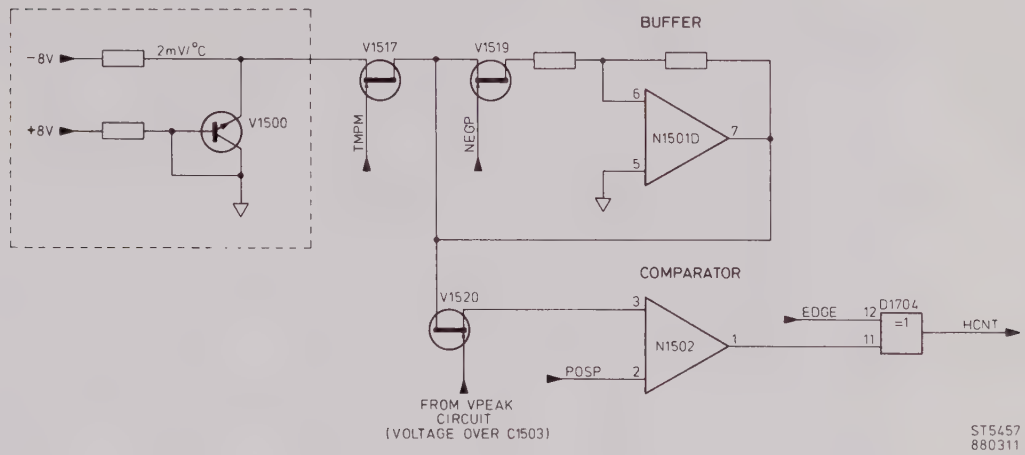
3n. Power supply

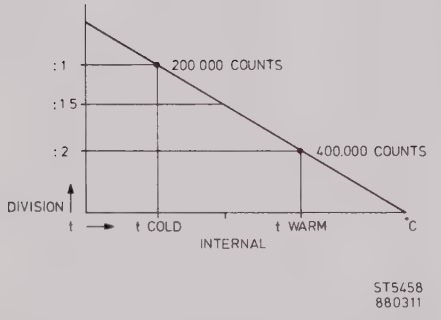
The PM2525 is suitable for mainssuply of 115 V and 230 V. The altering from 230 V to 115 V can be made on the pc-board.

3o. Function-switching

The function switch consists of a motor driven printed switch. Dependent on the function selected on the keyboard,the motor forces the switch to the correct position. The position is detected by the micro-processor.

3p. Internal temperature (A Vpeak measurement)





With t internal is is determined with what figure the result has to be divided.
tc and tw are relative.
tc = temperature for cold calibration
tw = temperatur for warm calibration

When calibrating:
Cold : Once a year to meet specification
Warm : In case of new ADC, Vpeak circuit, defect RAM

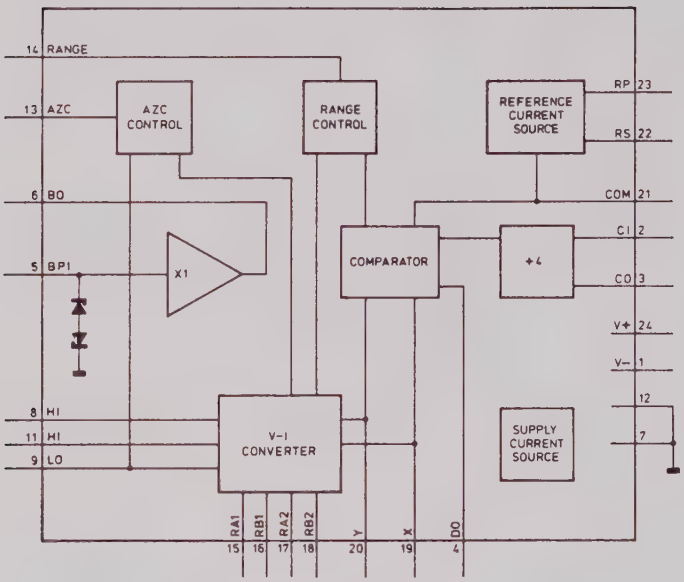
DISPLAY/KEYBOARD

The PCF 8576 is a circuit designed to drive a Liquid Crystal Display with up to 160 segments. A 2-line I^2C bus structure enables serial data transfer with the microcomputer.
A LCD is an AC device. Therefore, for multiplexing, the information of the segment line is imortant for each segment that will be driven by that line.
The reference voltage for the driver is obtained from transistor V2101 and zener diode V2101.
To change the viewing angle the reference voltage can be adjusted with potentiometer R2105.

On the same PCB the keyboard is situated. Pushing a switch will be read by the microcomputer via the I^2C bus. This is done by scanning lines P0 to P7 to obtain which switch is pressed.

COMPONENT DATA

OQ0067A BI-FET input ADC



Block diagram OQ0067A

DESCRIPTION

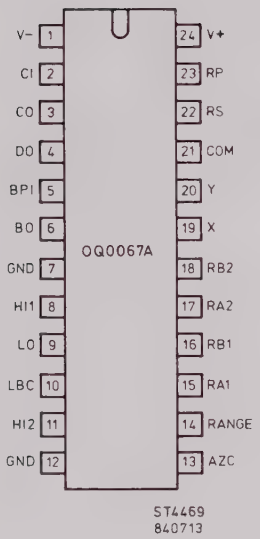
The OQ0067 is an ADC according to the Delta Modulator principle. It contains all the parts for a ADC. The output signal is an synchronus datasignal, which can be clocked in a microprocessor with a present clock. The display result is:

$$Disp = \frac{N \times Vin}{\frac{Iref}{2} \times Rconv}$$

N= the number of clockperiods during a measurement. The formule shows that the result will be more accurate with more clockperiods. This can be achieved with a longer measuring period or more clockpulses. To prevent offset voltages a AZC (auto zero compensation) input is available.

Every measuring period consists of two AZC periods. During the first AZC period the AZC input is logic low and the up counts the logic value of the datasignal on every edge of the clock. In the second AZC period the datasignal is inverted by the up. The up subtracts the logic value of the datasignal on every clock edge. At the same time the inputs of the ADC are interchanged. By this the input offset-voltage is eliminated. Via the range input a selection can be made between the two conversion resistors (input sensitivity 0.1V/1V).

PINNING & PIN FUNCTIONS



PIN NUMBER	NAME	DESCRIPTION
1	V -	Most negative supply & substrate
2	C1	Clock input
3	CO	ADC clock input
4	DO	ADC data output
5	BPI	Buffer & protection input
6	BO	Buffer output
8, 11	HI1,2	ADC HI inputs
9	LO	ADC LO input
10	LBC	Low buffer capacitor
7, 12	GND	Digital ground
13	AZC	AZC input
14	RANGE	Range input
15, 17	RA1,2	Range resistor A
16, 18	RB1,2	Range resistor B
19, 20	X, Y	Integrator capacitor
21	COM	Common point for current souce resistor
22	RS	Series resistor Current source
23	RP	Parallel resistor
24	V^+	Most positive supply

NOTE: pin numbers 7 and 12 are not connected together internally

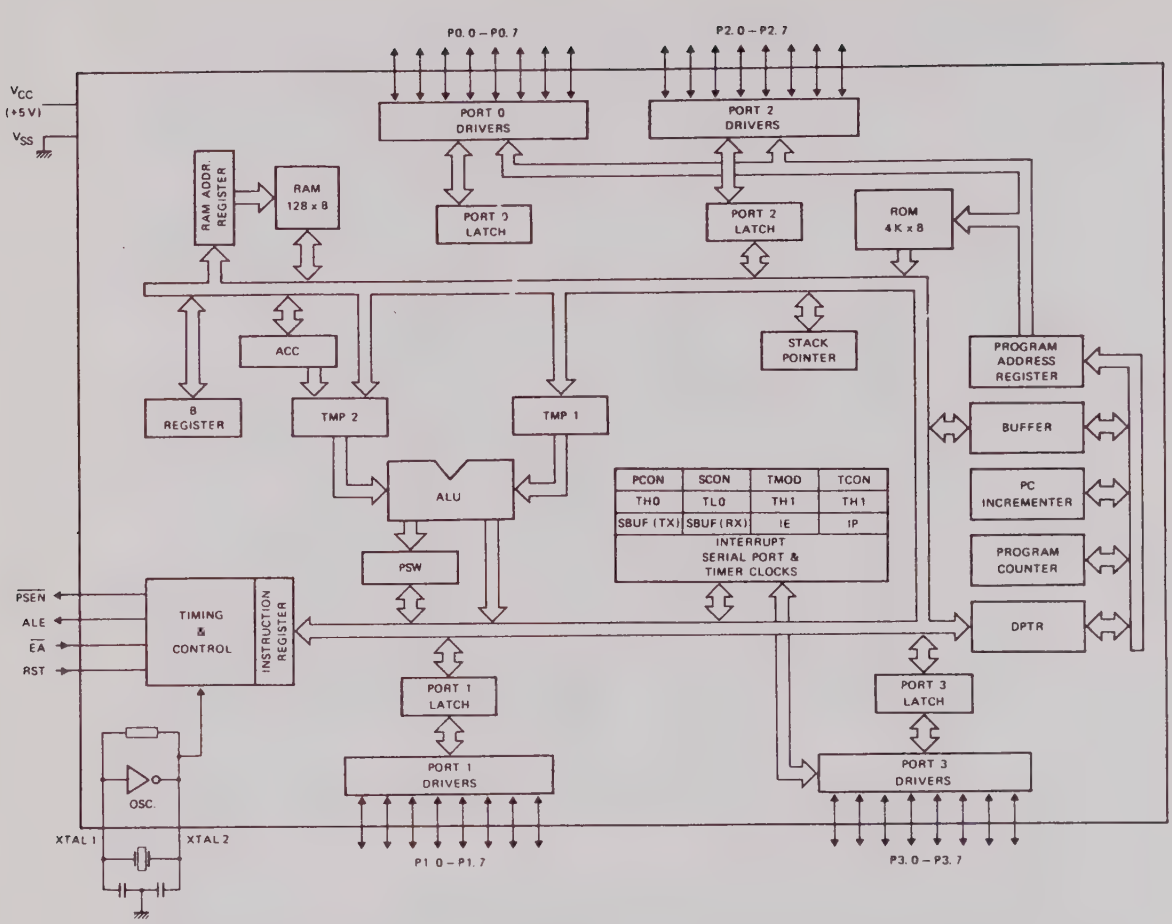
Pinning OQ0067A

8031AH single-component 8-bit microcomputer

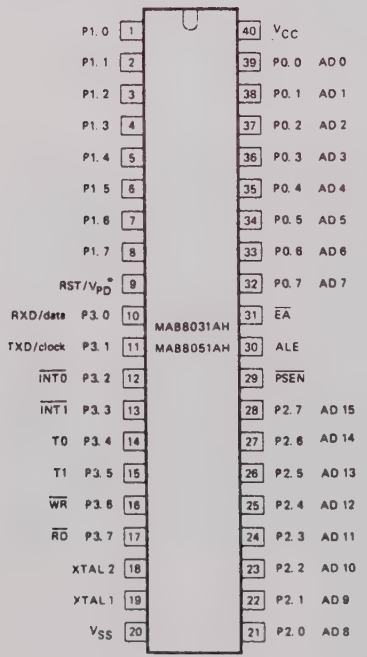
- 8031AH - Control-Oriented CPU with RAM and I/O
- 128K Accessible External Memory
- 218 User Bit-Addressable Locations
- 128 x 8 RAM
- 32 I/O Lines (Four 8-bBit Ports)
- Two 16-Bit Timer/Counters
- Programmable Full-Duplex Serial Channel

The 8031AH is Intel's HMOS version of the High performance 8-bit 8031 microcomputer. While the 8031AH features the same powerful architecture and instruction set as its HMOS predecessor, it offers the additional benefit of lower powerd supply current.

The 8031AH provides a cost-effective solution for those controller applications requiring up to 64 Kbytes of program and/or 64 Kbytes of data storage. Specifically, the 8031AH contains 128 bytes of read/write data memory; 21 I/O lines configured as four 8-bit parallel prots; two 16-bit timer/counters.



Block Diagram



Pin Configuration

8031AH PIN DESCRIPTIONS

V_{SS}
Circuit ground potential.

V_{CC}
5V power supply input for normal operation and program verification.

Port 0
Port 0 is an 8-bit open drain bidirectional I/0 port. It is also the multiplexed low-order address and data bus when using external memory. It is used for data output during program verification. Port 0 can sink (and in bus operations can source) eight LS TTL loads.

Port 1
Port 1 is an 8-bit quasi-bidirectional I/0 port. It also emits the high-order address byte when accessing external memory. It is used for the high-order address and the control signals during program verification. Port 2 can sink/source for LS TTL loads.

Port 3
Port 3 is and 8-bit bidirectional I/= port with internal pullups. It also serves the functions of various spcial features of the MCS-51 Family, as listed below:

Port Pin	Alternate Function
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	INT0 (external interrupt)
P3.3	INT1 (external interrupt)
P3.4	T0 (Timer/counter 0 external input)
P3.5	T1 (Timer/counter 1 external input)
P3.6	WR (external Data Memory write strobe)
P3.7	RD (external Data Memory read strobe)

The output latch corresponding to a seconary function must be programmed to a one (1) for that function to operate. Port 3 can sink/source four LS TTL loads.

RST
A high on this pin for two machine cycles while the oscillator is running resets the device. A small external pulldown resistor (8,2k) from RST to V_{SS} permits power on reset when a capacitor (10uF) is also connected from this pin to V_{CC}.

ALE
Address Latch Enable output for latching the low byte of the address during accesses to external memory. ALE is activated at a constant rate of 1/6 the oscillator frequency except during an external data memory access at which time one ALE pulse is skipped. ALE can sink/source 8 LS TTL inputs.

PSEN
The Program Store Enable output is a control signal that enables the external Program Memory to the bus during external fetch operations. It is activated every six oscillator periods except during external data memory access. PSEN remains high during internal program execution.

EA
When held at a TTL high level, the 8051AH executes instructions from the internal ROM when the PC is less than 4096. When held at a TTL-low level, the 8031AH/8051AH fetches all instructions from external Program Memory. Do not float EA during normal operation.

XTAL 1
Input to the inverting amplifier that forms part of the oscillator. This pin should be connected to ground when an external oscillator is used.

XTAL 2
Output o the inverting amplifier that forms part of the oscillator, and input to the oscillator signal when an external oscillator is used.

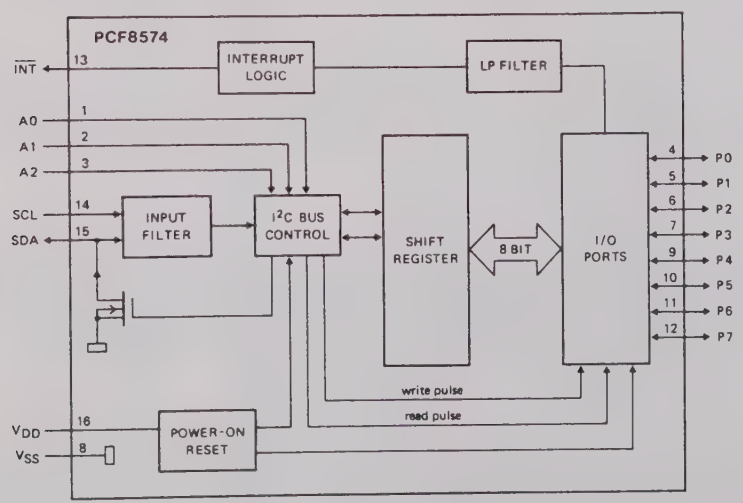
PCF8574 remote 8-bit I/O for I^2C bus

DESCRIPTION

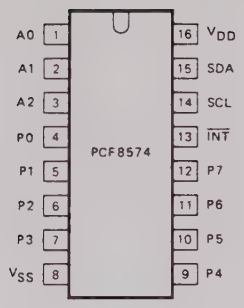
The PCF8574 is a single-chip silicon gate CMOS circuit. It provides remote I/O expansion for the MAB8400 and PCF8500 microcomputer families via the two-line serial bidirectional bus (I^2C). The device consists of an 8-bit quasi-bidirectional port and an I^2C interface. The PCF8574 has low current consumption and includes latched outpus with high current drive capability for directly driving LEDs.

Features

- Operating supply voltage 2,5 V to 6 V
- Biderectional expander
- Open drain interrupt output
- 8-bit remote I/O port for the I^2C bus
- Latched outputs with high current drive capability for directly driving LEDs
- Address by 3 hardware address pins for the use of up to 8 devices (up to 16 possible with mask option)



Block diagram

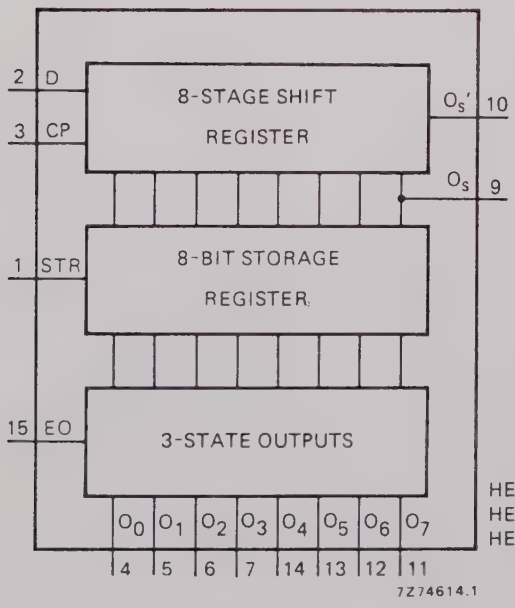


1 to 3	A0 to A2	address inputs
4 to 7	P0 to P3	8-bit quasi-bidirectional I/O
9 to 12	P4 to P7	port
8	V_{SS}	negative supply
13	$\overline{INT}$	interrupt output
14	SCL	serial clock line
15	SDA	serial data line
16	V_{DD}	positive supply

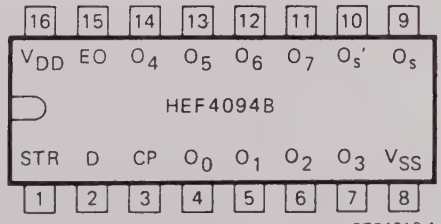
Pinning diagram

8-STAGE SHIFT-AND-STORE BUS REGISTER

The HEF4094B is an 8-stage serial shift register having a storage latch associated with each stage for strobing data from the serial input to parallel buffered 3-state oupus O_0 to O_7. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive-going clock transitions. The data in each shift register stage is transferred to the storage register when the strobe (STR) input is HIGH. Data in the storage register appears at the outputs whenever the output enable (EO) signal is HIGH.
Two serial outputs (O_s and O_s') are available for cascading a number of HEF4094B devices. Data is available at O_s on positive-going clock edges to allow high-speed operation in cascaded systems in which the clock rise time is fast. The same serial information is available at O_s' on the next negative-going clock edge and provides cascading HEF4094B devices when the clock rise time is slow.



Functional diagram



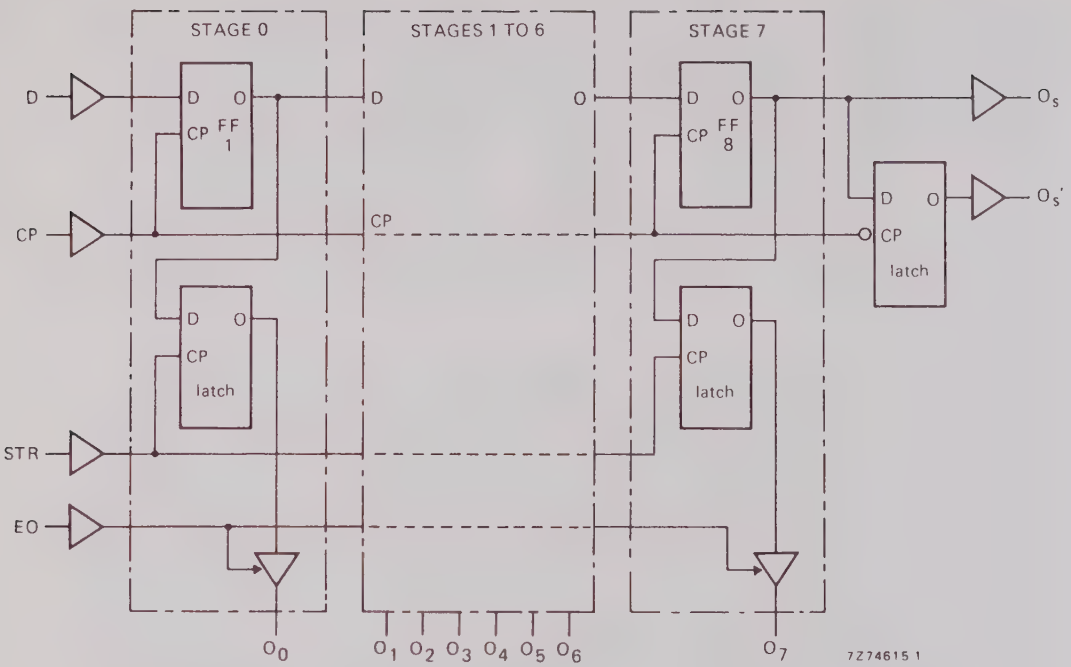
Pinning diagram

HEF4094BP : 16-lead DIL; plastic (SOT-38Z).
HEF4094BD: 16-lead DIL; ceramic (cerdip) (SOT-74).
HEF4094BT : 16-lead mini-pack; plastic (SO-16; SOT-109A).

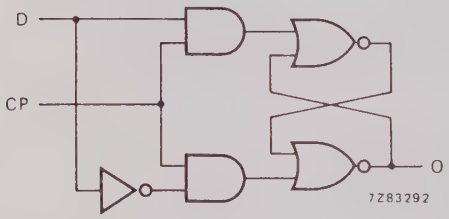
PINNING

D	data input	EO	output enable input
CP	clock input	O_s, O_s'	serial outputs
STR	strobe input	O_0 to O_7	parallel outputs

FAMILY DATA
I_{DD} LIMITS category MSI } see Family Specifications



Logic diagram



One D-latch

FUNCTION TABLE

inputs				parallel outputs		serial outputs	
CP	EO	STR	D	O_0	O_n	O_s	O_s'
∫	L	X	X	Z	Z	O_6'	nc
⌞	L	X	X	Z	Z	nc	O_7
∫	H	L	X	nc	nc	O_6'	nc
∫	H	H	L	L	O_{n-1}	O_6'	nc
∫	H	H	H	H	O_{n-1}	O_6'	nc
⌞	H	H	H	nc	nc	nc	O_7

H = HIGH state (the more positive voltage)
L = LOW state (the less positive voltage)
X = state is immaterial
∫ = positive-going transition
⌞ = negative-going transition
Z = high impedance off state
nc = no change
O_6' = the information in the seventh shift register stage

At the positive clock edge the information in the 7th register stage is transferred to the 8th register stage and the O_s output.

A.C. CHARACTERISTICS

V_{SS} = 0 V; T_{amb} = 25 °C; input transition times ⩽ 20 ns

	V_{DD} V	typical formula for P (μW)	where
Dynamic power dissipation per package (P)	5	$2100\ f_i + \Sigma(f_oC_L) \times V_{DD}^2$	f_i = input freq. (MHz) f_o = output freq. (MHz) C_L = load capacitance (pF) $\Sigma(f_oC_L)$ = sum of outputs V_{DD} = supply voltage (V)
	10	$9700\ f_i + \Sigma(f_oC_L) \times V_{DD}^2$	
	15	$26\,000\ f_i + \Sigma(f_oC_L) \times V_{DD}^2$	

4. DISMANTLING THE INSTRUMENT

GENERAL INFORMATION

This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the instrument must be adquately proteced against damage, and all normal precautions regarding the use fo tools must be observed. During dismantling a careful note must be made of all disconnected leads so that they can be reconnected to their correct terminals during re-assembly.

CAUTION: Damage may result if:
- the instrument is switched on when a circuit board has been removed.
- a circuit board is removed within one minute after switching-off the instrument.

Disconnect measuring terminals before opening.

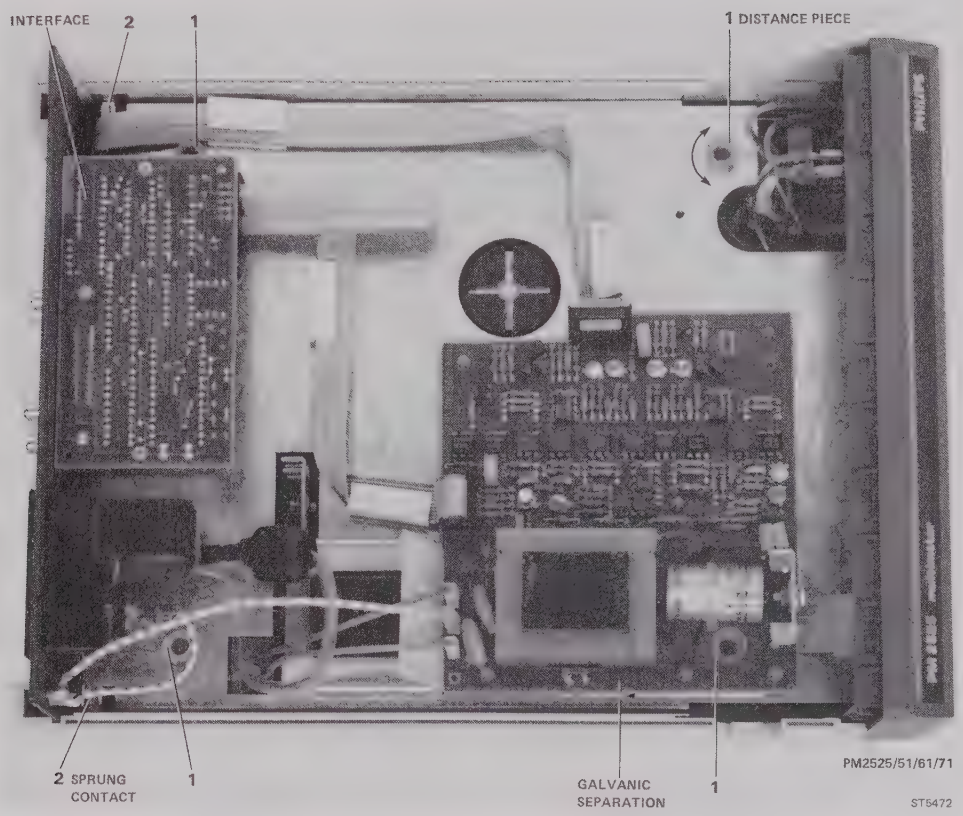
4.1 REMOVING THE TOPCOVER

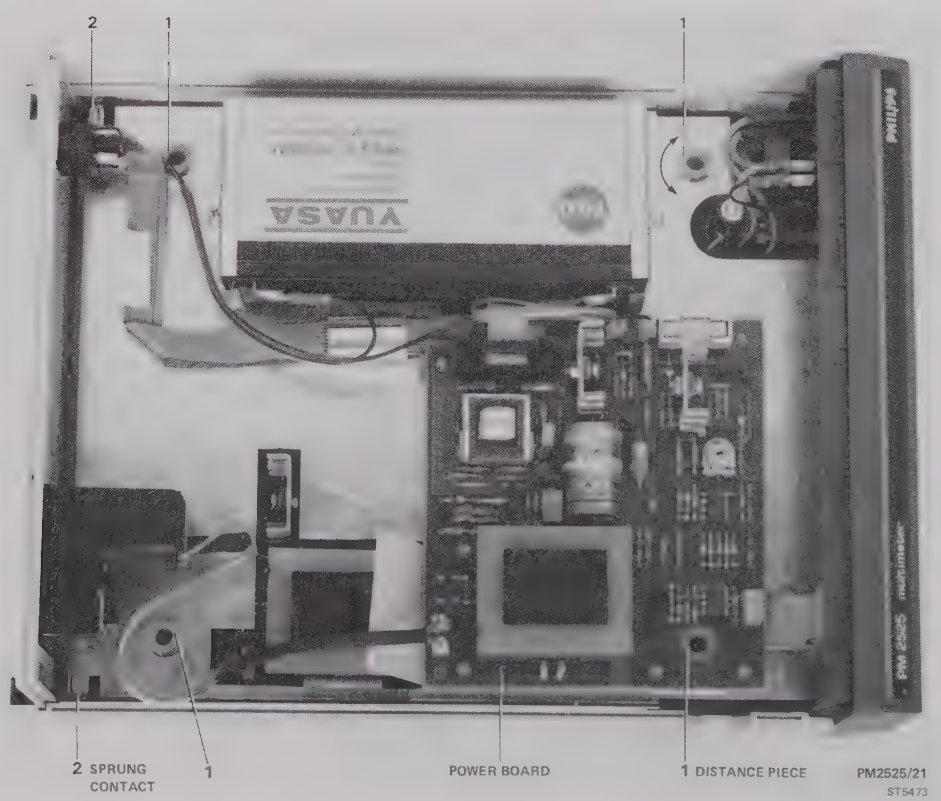
- Place the carrying handle in the bottom position.
- Loosen the four fixing screws (torx screws) that are situated in the four feet.

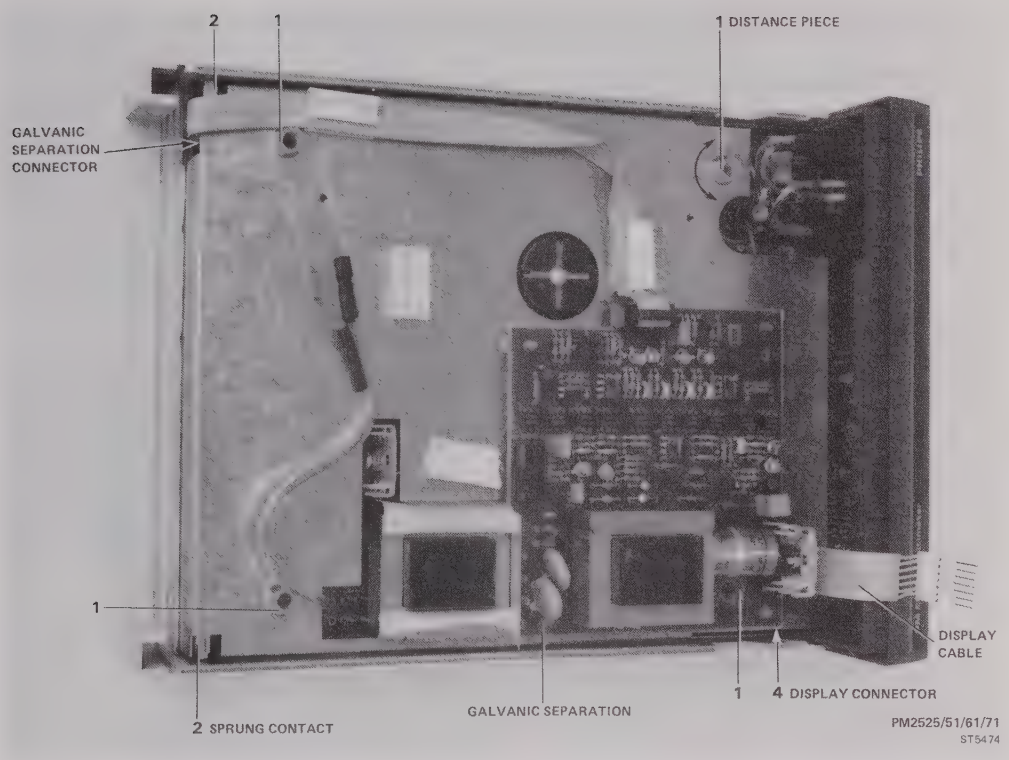
  Remark: The fixing screws can be loosened with a TORX screwdriver, size T10.

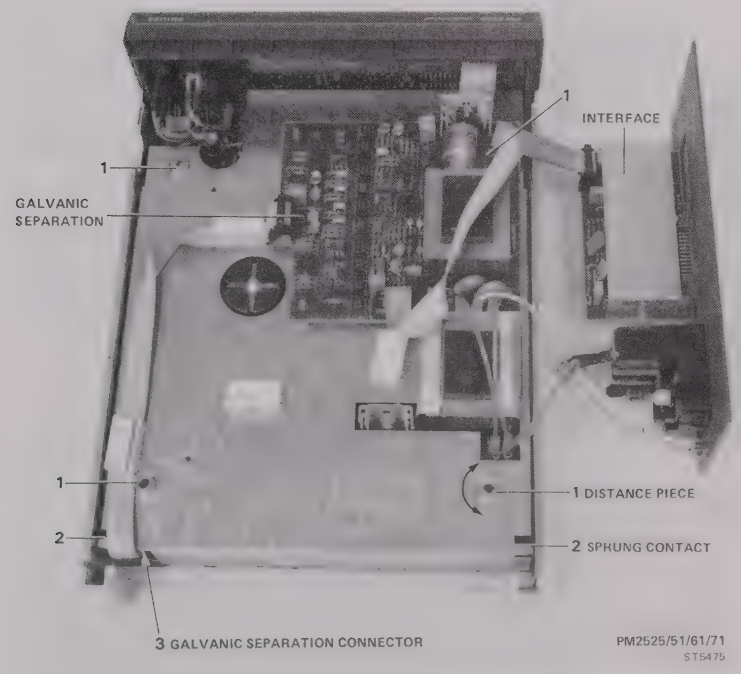
- Lever the topcover and pull it upwards.

4.2 REMOVING THE TOP-SCREENING






2
1
1 DISTANCE PIECE
GALVANIC
SEPARATION
CONNECTOR
1
DISPLAY
CABLE
1
4 DISPLAY CONNECTOR
GALVANIC SEPARATION
2 SPRUNG CONTACT
PM2525/51/61/71
ST5474


1
INTERFACE
1
GALVANIC
SEPARATION
1
1 DISTANCE PIECE
2
2 SPRUNG CONTACT
3 GALVANIC SEPARATION CONNECTOR
PM2525/51/61/71
ST5475

- Remove the topcover.
- Remove the wiring from the backplate.

  Remark: For version /01 there is only mains power wiring.

- Loosen the display cable from the display board.
- Turn the distance pieces (1).
- Lift the screening out-off the instrument.

  Remarks: The display cable is connected to the mother board (4).

  The galvanic separation is connected to the mother board (3).

  When mounting the top screening first make the connections (3) (4) and make sure that the sprung contacts (2) are fitted well.

4.3 REMOVING THE BOTTOMCOVER

- Remove the topcover.
- Remove the top-screening.
- The mother board including the front assembly is fixed with one Phillips screw to the bottom cover. The screw is situated near the mains-transformer.
- Pull the bottom cover from the instrument.

4.4 REMOVING THE FRONT-ASSEMBLY

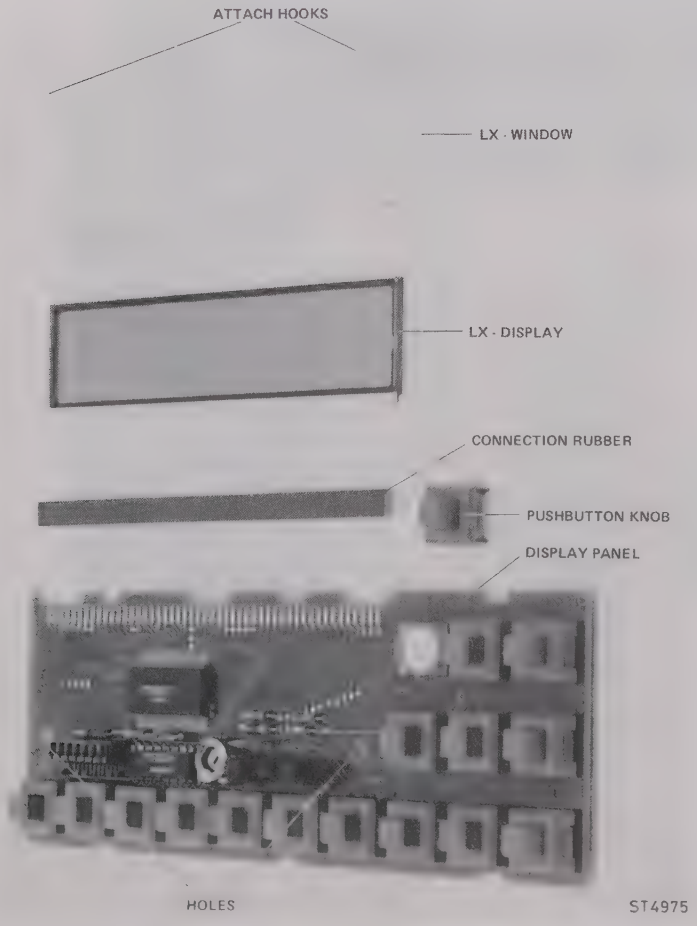
- Remove the topcover.
- Remove the top-screening.
- Remove the bottom cover.
- Bend-out the two hooks of the front-assembly.
  The two plastic clip-hooks can be reached at the component side of the mother board near the front.
- Pull the front from the mother board.

4.5 LX- DISPLAY, WINDOW AND INTERCONNECTION RUBBER

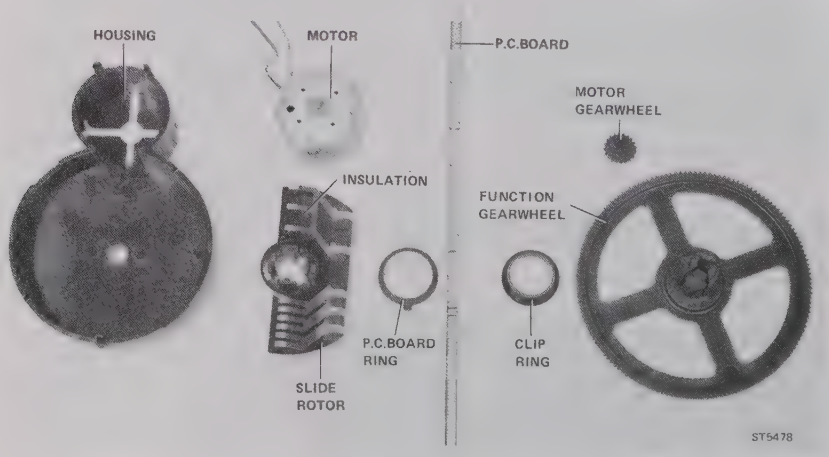
- Dismantle.
- Remove screening.
- Remove front assembly.
- Bend out the six hooks and lift the PCB out of the front assembly.

- Push the attach hooks out of the holes at the component side of the PCB and lift the LCD display from the PCB.

The assembly of the display consists of four main parts.
All parts can be replaced seperately.



4.6 REPLACING THE FUNCTION SELECTOR



- Remove the topcover.
- Remove the top-screening

Replace of the function gearwheel

- Use a M5.5mm Box-spanner to press the gearwheel out of the function selector housing. A box-spanner is used to compress the retaining lugs of the gearwheel simultaneously.

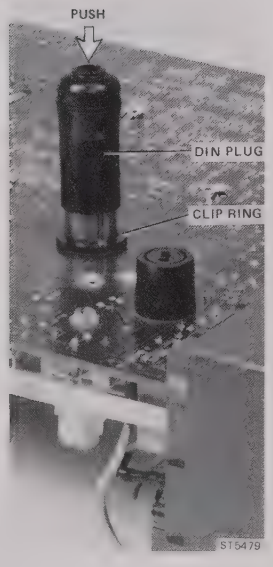
  The gearwheel is keyed so no erroneous mounting is possible.

Replace of function selector housing assembly.
(Housing, motor, motor gearwheel)

- Remove function gearwheel.
- The function selector housing including motor assembly can be pressed out of the p.c. board from the bottom side on. (three lugs)
- The motor gearwheel can be pulled of the motor pinion.
- The motor can be pulled out of the housing with a screwdriver.

Replace of the function slide-rotor assembly

- Remove function gearwheel.
- Remove function selector housing assembly.
- The function selector assembly consists of a clipring, a p.c. board ring, slide rotor assembly (rotor + insulation)
- Push the rotor out of the clipring with a screwdriver or a DIN-plug at the conductor-side of the mother p.c. board.



5. CHECKING AND ADJUSTING THE PM2525 (all versions)

5.1 GENERAL INFORMATION

The following information provides the complete checking and adjusting procedures for the instrument. As various control functions are interdependent, a certain order of adjustment is necessary. The procedure is , therefore, presented in a sequence which is best suited to this order, cros-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Where possible, instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this section are calibration guides, and should be not interpreted as instrument specifications unless they are also published in section 2.
- Tolerances given are for the instrument under test and do not include test equipment error.
- All controls which are mentioned without item numbers are located on the outside of the instrument.

WHY CALIBRATING AT TWO TEMPERATURES

Calibration will be made to get exact values without tolerances. Measuring at various temperatures will give different measuring data. Hot calibration will take care of the compensation of the different measuring data which originate by temperature variations.

THE CALIBRATION CAN BE SUBDIVIDED INTO:

5.2	Preparations	
5.3	Manual course adjustment	,open instrument
5.4	Manual fine adjustment	,open instrument
5.5	Electronic calibration cold and hot	,closed instrument

The coarse/fine adjustment and the calibration hot have to be carried out only when components have been replaced.

If the following components have been replaced, parts or the complete hot calibration has to be made.

Component	Hot calibration number
R1334 R1337	NO 42 100 mADC
R1532	NO 19 200 MΩ NO 40 20 MΩ
C1503 R1203, R1204 R1212, R1213 R1216, R1217 R1530, R1533 R1535, R1536 R1537, R1538 R1548, RA10	ALL
N1202 N1501C N1502	
V1500, V1555	
D1201 00302 A1203 0Q0067 D1711 RAM	

In case of hot calibration, the cold calibration has to be done first, in the sequence which is given in section 5.5.7.
After this the hot calibration can be made in the same sequence.

The cold calibration has to be made once a year to quaranty the specification.

5.2 PREPARATIONS FOR CALIBRATION

5.2.1 Preparations for manual adjustment.

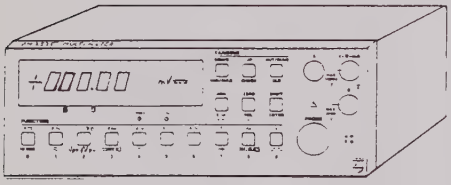
Hardware adjustments only must be made if components have been replaced.
For hardware adjusting No 1 to 9, the instrument must be opened (see chapter 4).
Before starting measuring and adjusting the diodes V1354,V1355,V1350 and V1351 must be covered because the light has influence on the measuring data.
For adjusting No 2 use a measuring lead with an build-in resistor of 14 kohm.

5.2.2 Preparations for electronic calibration.

In case of cold calibration the ambient temperature and the temperature of the instrument must be between +20 and +26°C +/-1°C
In case of hot calibration the ambient temperature and the temperature of the instrument must be between +33 and +40°C +/-5°C
Be sure the instrument is closed. In fig. 5.3 examples are shown to control the instrument.

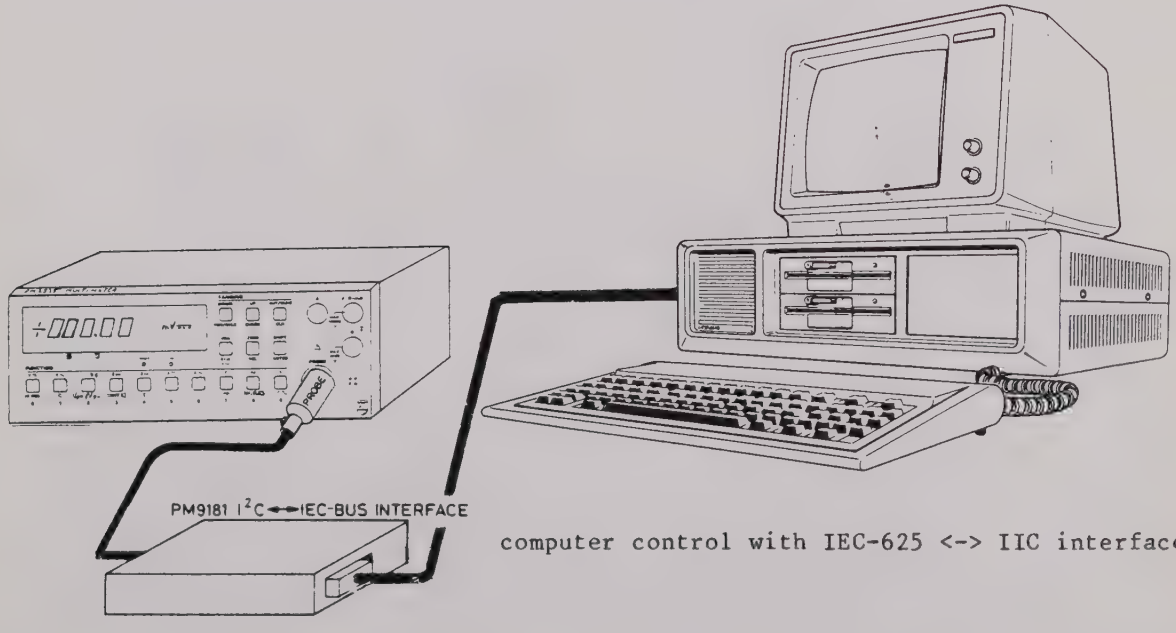
5.2.3 Following instruments and accesories can be used for calibration.

Calibrator	(eg. FLUKE 5100)
Frequency generator	(eg. PM5390)
Interface IEC-625 <-> IIC	(eg. PM9181)
Four wire measuring lead	(eg. PM9264/01)
Resistorbox 30 Mohm	(see chapter 5.7.3)
Resistor 1 Mohm +/-0.1%	
Oven for hot calibration	



Manual control

Computer control with IEC-625 or RS232C/V24 interface.



computer control with IEC-625 <-> IIC interface.

Different ways of how to control the PM2525

5.3 COARSE ADJUSTMENTS (open instrument, only if components have been replaced)

Overview

Adj.number	Adjustment	P.C. Board version		
		a	b	
1	2 Vpp	R2	x	x*
2	Iref. ADC 0Q0067A	R1	x	x
3	I compensation	R3	x**	x
4	1 mA ⎓	R1316	x	x
5	1 uA ⎓	R1311	x	x
6	2 V ≂	C1105	x	x
7	20 V ~	C1108	x	x
8	200 V ~	C1111	x	x
9	2 V ~	R4	x** *	- dependent on value of C1201

* Modified adjustment ** On component side

5.3.1 Adjusting of 2 VPP *

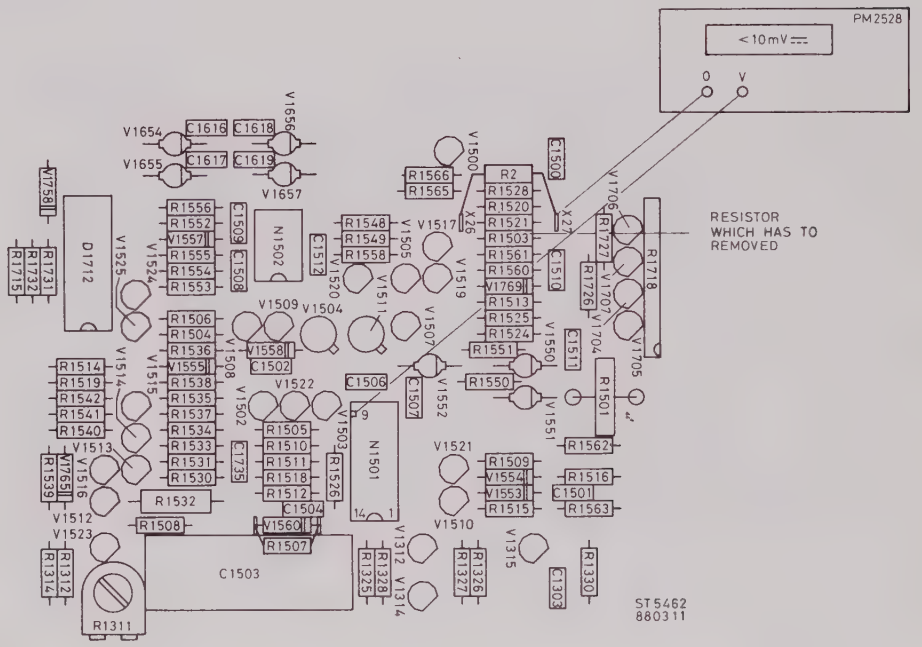
* Modified adjustment

No	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNAL	MEASURING DATA	MEASURING POINT
1	VPP range 2V	R2 adjust resistor (MR25 1% E48 series) * R1503 removable resistor	Instrument set in position VPP. 2V. Use a PM2528.	Open input	< 10 mV ⎓ ± 0.1%	HI = N1501/9 LO = X 27

- Adjusting elements mother P.C. board a.

U N1501/9-X27	R2	REMOVE
>= 9.9.....<12.1 mV	44k2	
>= 7.7.....< 9.9 mV	56k2	
>= 5.5.....< 7.7 mV	75k	
>= 3.3.....< 5.5 mV	115k	
>= 1.1.....< 3.3 mV	226k	
>=-1.1.....< 1.1 mV		
>=-3.3.....<-1.1 mV	24k9	R1503
>=-5.5.....<-3.3 mV	30k1	R1503
>=-7.7.....<-5.5 mV	33k2	R1503
>=-9.9.....<-7.7 mV	38k3	R1503
>=-12.1....<-9.9 mV	44k2	R1503

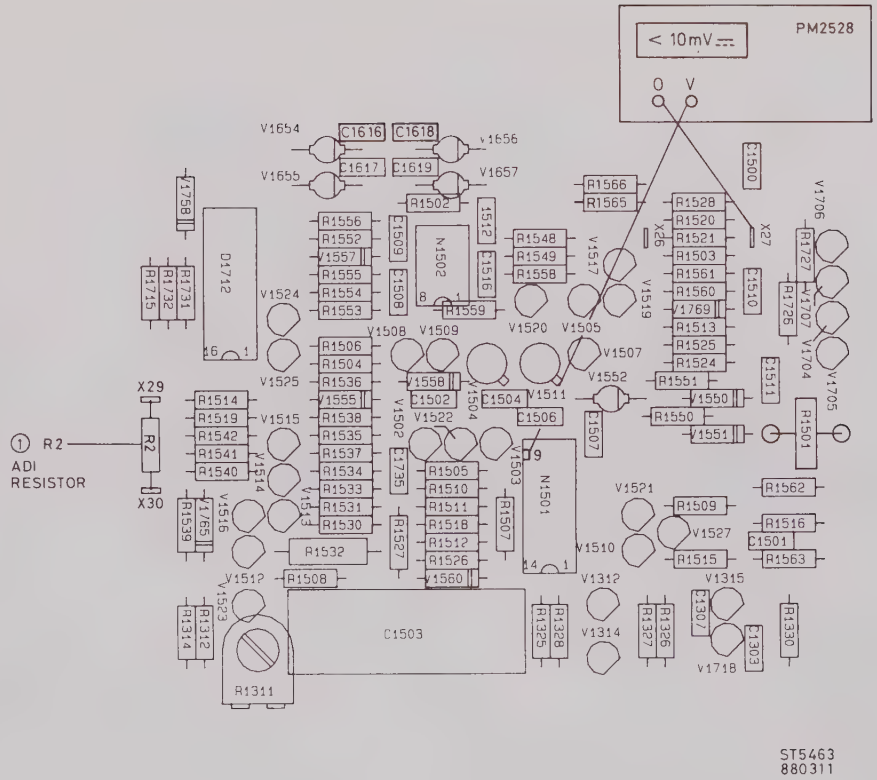
NOTE: When measuring and adjusting in an open instrument the diodes V1354, V1355, V1350, V1351 must be covered, to eliminate the influence of light.



- Adjusting element mother P.C. board b.

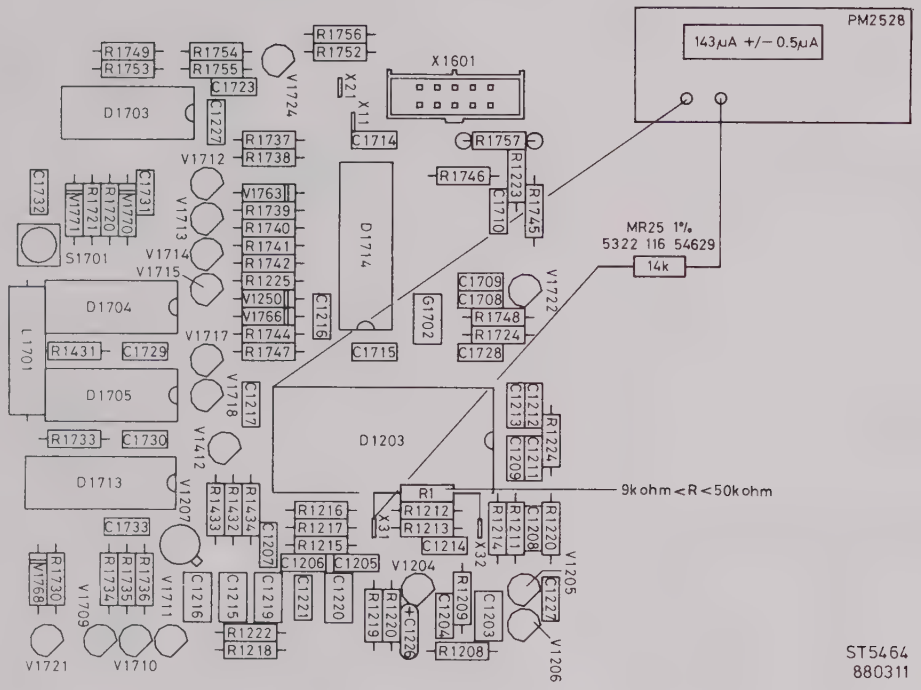
U N1501/09 - X27	R2
< 25 mV .. > 23 mV	86k6
< 23 mV .. > 21 mV	95k3
< 21 mV .. > 19 mV	105k
< 17 mV .. > 15 mV	127k
< 15 mV .. > 13 mV	147k
< 13 mV .. > 11 mV	169k
< 11 mV .. > 9 mV	205k
< 7 mV .. > 5 mV	261k
< 5 mV .. > 3 mV	511k
< 19 mV .. > 17 mV	11k

NOTE: When measuring and adjusting in an open instrument the diodes V1350, V1351, V1354, V1355 must be covered, to eliminate the influence of light.



5.3.2 Adjusting the OQ0067A

No	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNAL	MEASURING DATA	MEASURING POINT
2	Reference current ADC OQ 0067A	R1 adjust resistor 9kohm< R >50kohm (MR25 1% E48 series)	Instrument set in position V ⎓ AUT Use PM2528 and a help resistor,	Open input	+143uA +/- 0.5uA	HI = X31 LO = D1203/12



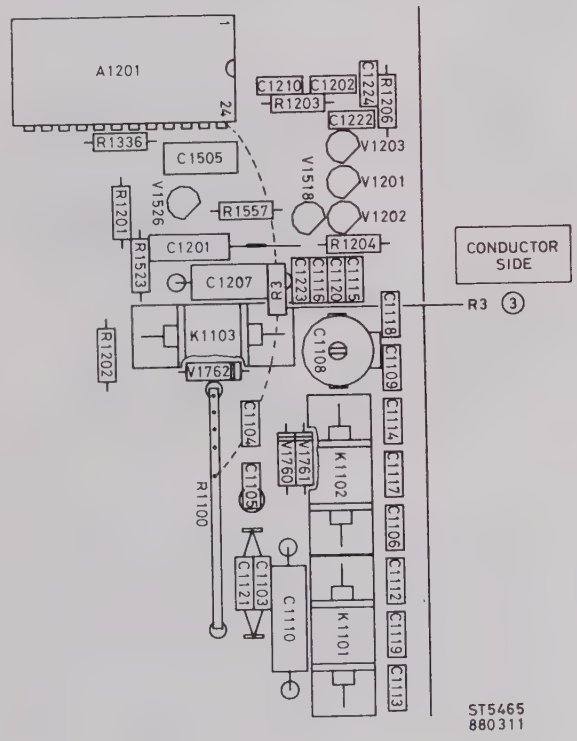
NOTE: When measuring and adjusting in an open instrument the diodes V1354, V1355, V1350, V1351 must be covered, to eliminated the influence of light.

5.3.3 Input current compensation*

* Modified adjustment

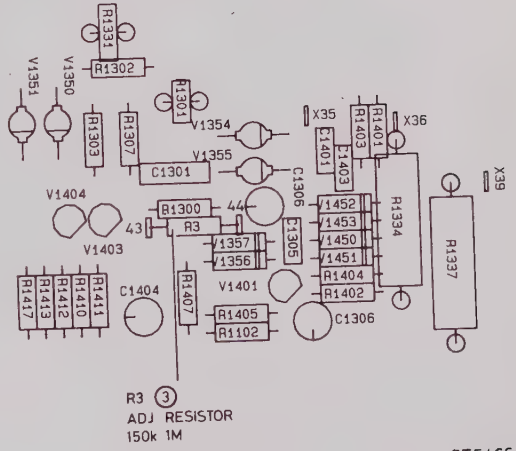
No	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNAL	MEASURING DATA	MEASURING POINT
3	I input	R3 adjust resistor (MR25 1% E48 series) 150k -> IM.	Select V ⎓, 200 mV	Open and short-circuited input	R3=200 / Ushortcct-Uopen	Display

- Adjusting elements mother P.C. board a.



ST5465
880311

- Adjusting element mother P.C. board b.



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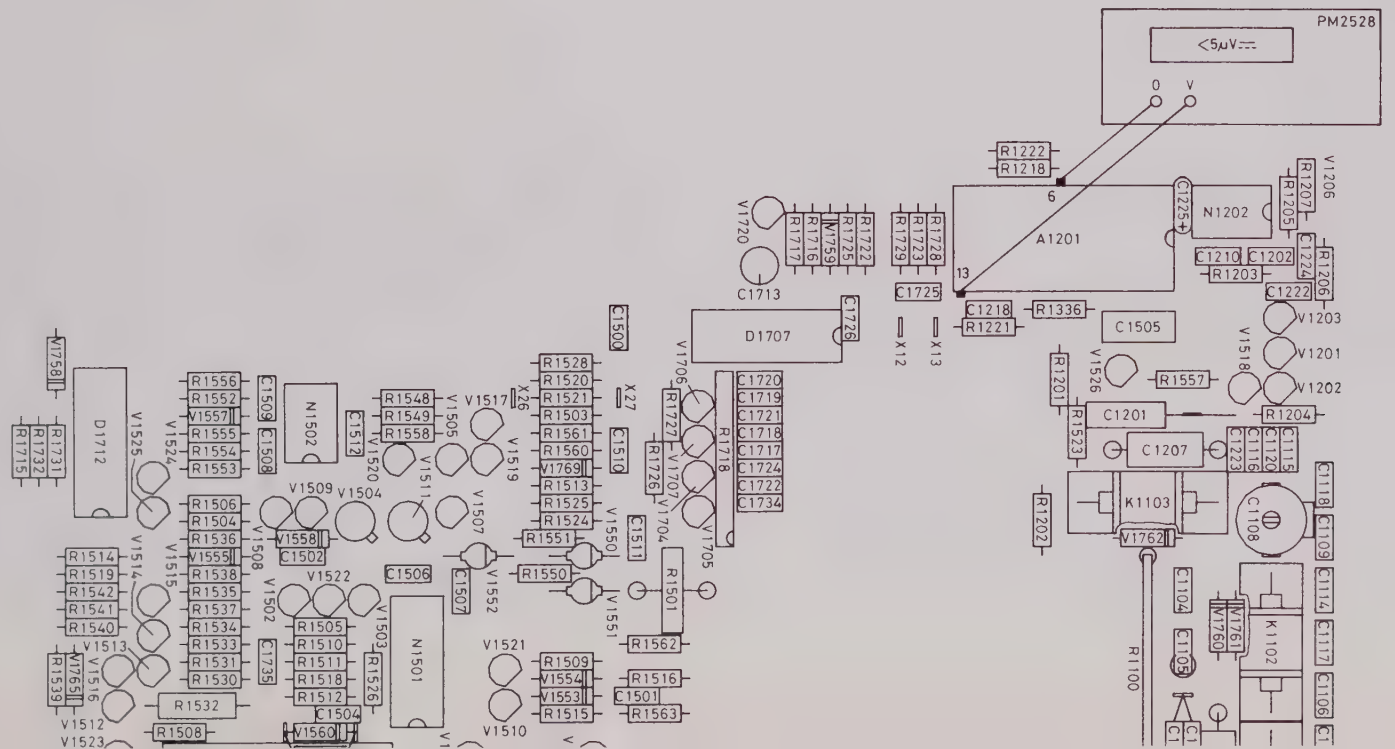
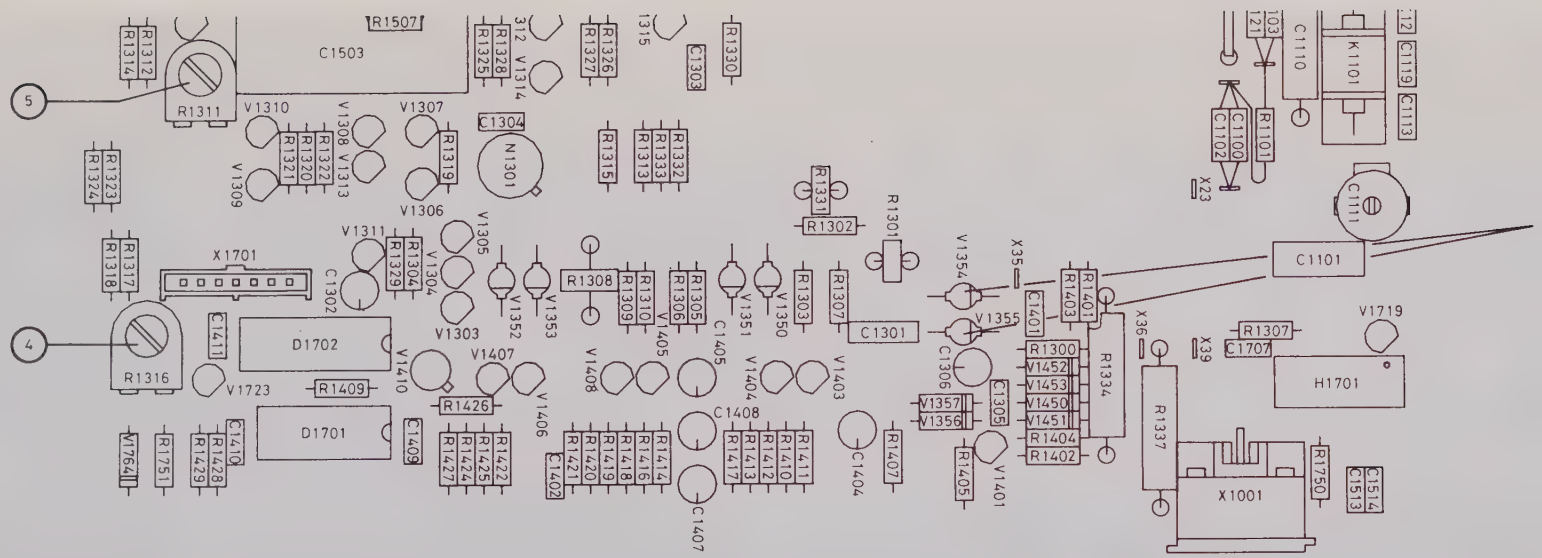
NOTE: When measuring and adjusting in an open instrument the diodes V1350, V1351, V1355, V1354, must be covered to eliminate the influence of light.

5.4 FINE ADJUSTMENT (Open instrument, only if components have been replaced)

5.4.1 Fine adjustment DC current

No	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNAL	MEASURING DATA	MEASURING POINT
4	IDC range 1mA	Potentiometer R1316	Instrument set in position A ⎓ 1mA use a PM2528 see figure below	Open input	< 5 uV ⎓	HI = A1201/13 LO = A1201/6 see figure below
5	IDC range 1uA	Potentiometer R1311	Instrument set in position A ⎓ 1uA use a PM2528 see figure below	Open input	< 5 uV⎓	HI = A1201/13 LO = A1201/6 see figure below





ST5467
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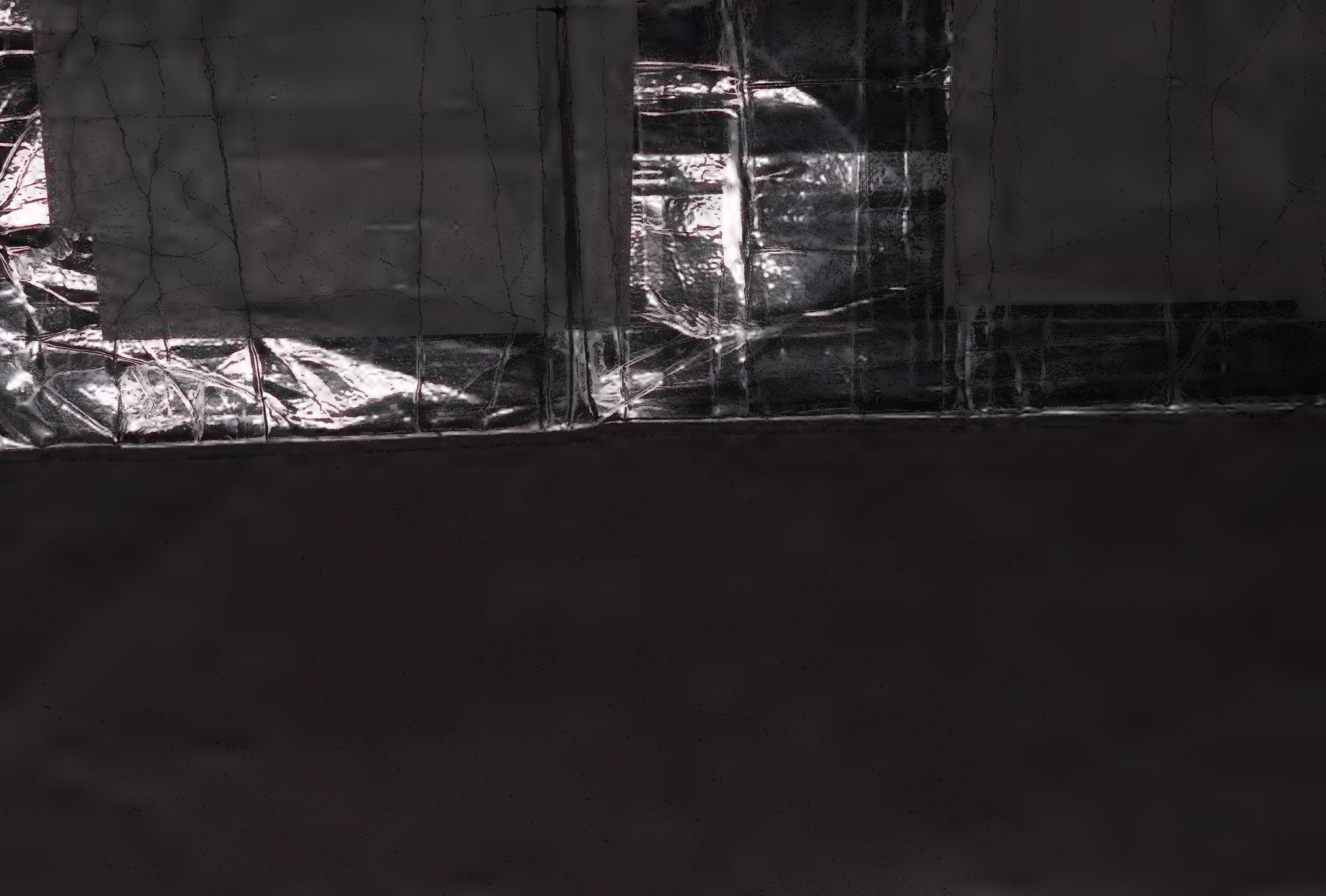
NOTE: When measuring and adjusting in an open instrument the diodes V1354, V1355, V1350, V1351 must be covered, to eliminated the influence of light.



5.4.2 Fine adjustment AC voltage

No	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNAL	MEASURING DATA	MEASURING POINT
6	VAC range 2 V	Trimmer C1105 Removeble capacitor see table 1	Instrument set in position 2 V.	1.7 V 600 Hz +/- 0.08%	1.7000 V +/- 15 dig.	See display
7	VAC range 20 V	Trimmer C1108 Removeble capacitor see table 2	Instrument set in position 20 V.	17 V 600 Hz +/- 0.2%	17.000 V +/- 15 dig.	See display
8	VAC range 200 V	Trimmer C1111 Removeble capacitor see table 3	Instrument set in position 200 V.	170 V 600 Hz +/- 0.2%	170.00 V +/- 15 dig.	See display

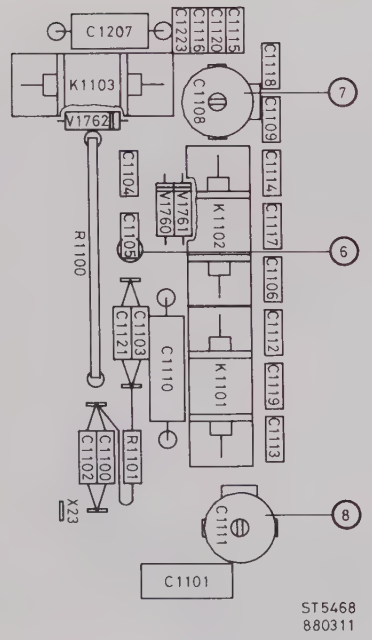


TABLE 2			
TRIMMER C 1108			
REMOVE	C1109	C1118	DEVIATION IN DIGITS
			0-----406
		X	407---768
	X		769--1107
	X	X	1108-1490

TABLE 1		
TRIMMER C 1105		
REMOVE	C1106	DEVIATION IN DIGITS
		0----1496
	X	1497-3272

NOTE: When measuring and adjusting in an open instrument the diodes V1354, V1355, V1350, V1351 must be covered, to eliminated the influence of light.

TABLE 3						
TRIMMER C 1111						
REMOVE	C1117	C1119	C1114	C1113	C1112	DEVIATION IN DIGITS
						0----38
					X	39----77
				X		78----117
				X	X	118----155
			X			156----191
			X		X	192----234
			X	X		235----275
			X	X	X	276----303
		X				304----332
		X			X	333----363
		X		X		364----399
		X		X	X	400----447
		X	X			448----490
		X	X		X	491----525
		X	X	X		526----561
		X	X	X	X	562----610
	X					611----657
	X				X	658----693
	X			X		694----729
	X			X	X	730----770
	X		X			771----811
	X		X		X	812----846
	X		X	X		847----880
	X		X	X	X	881----902
	X	X				903----933
	X	X			X	934----966
	X	X		X		967----999
	X	X		X	X	1000--1035
	X	X	X			1036--1069
	X	X	X		X	1070--1100
	X	X	X	X		1101--1127
	X	X	X	X	X	1128--1160

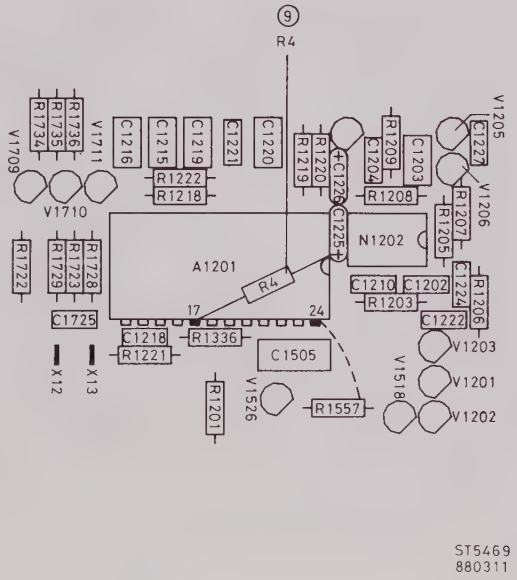
5.4.3 Fine adjustment 2 V≂

* Modified adjustment

No	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNAL	MEASURING DATA	MEASURING POINT
9	2 V≂	R4 (MR25 1% E48 series)	- Select function 2 V≂ - Supply -1.9 V - Press ZERO - Supply 1.9 V 60 Hz	-1.9 V ⎓ 1.9 V~ 60Hz	Difference between -1.9 V ⎓ and 1.9 V~ 60 Hz See table	DISPLAY

Dependent on the value of C1201 on of the tables should be selected.

C1201 = 100 nF	
Difference	R4
180---167	619k
166---156	681k
155---145	750k
144---135	823k
134---126	909k
125---118	1M
117---111	1M1
110---105	1M2
104----98	1M3
97-----91	1M5
90-----87	1M6
86-----81	1M8
80-----75	2M
74-----69	2M4
68------0	2M7



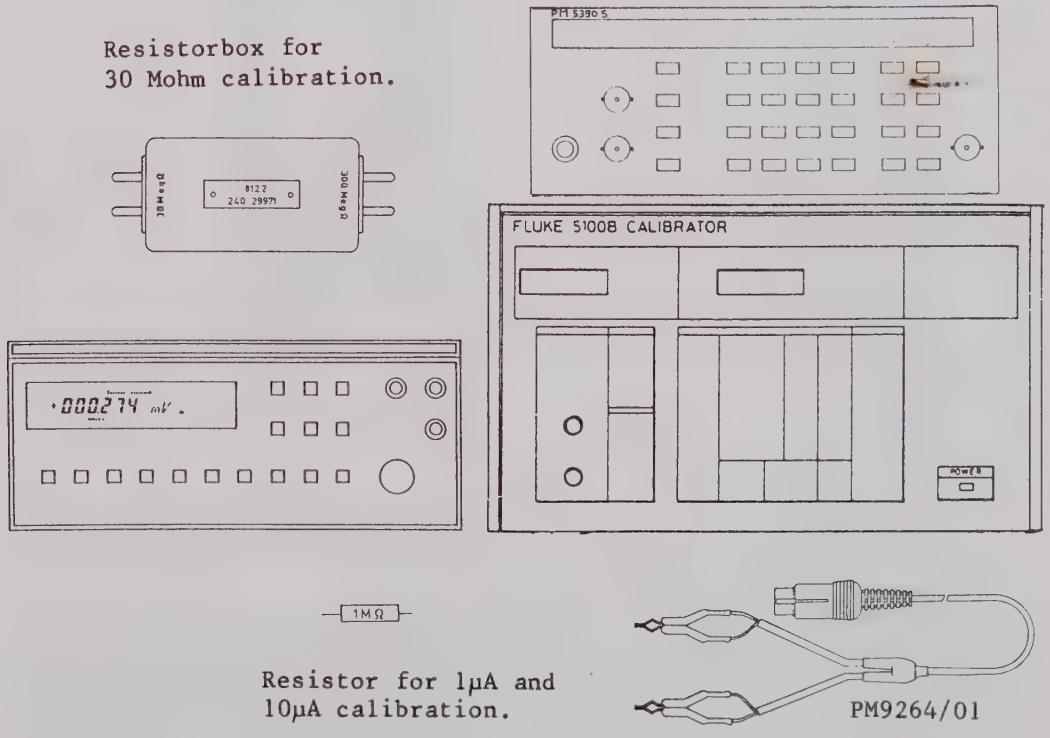
C1201 = 33 nF	
Difference	R4
0------47	2M
48-----62	1M5
63-----76	1M2
77-----90	953k
91----105	787k
106---119	715k
120---133	649k
134---147	562k
148---162	511k
163---176	487k
177---190	442k
191---204	402k
205---219	365k
220---233	332k
234---247	316k
248---287	287k

5.5.1 How to switch on the cold calibration mode by manual control.

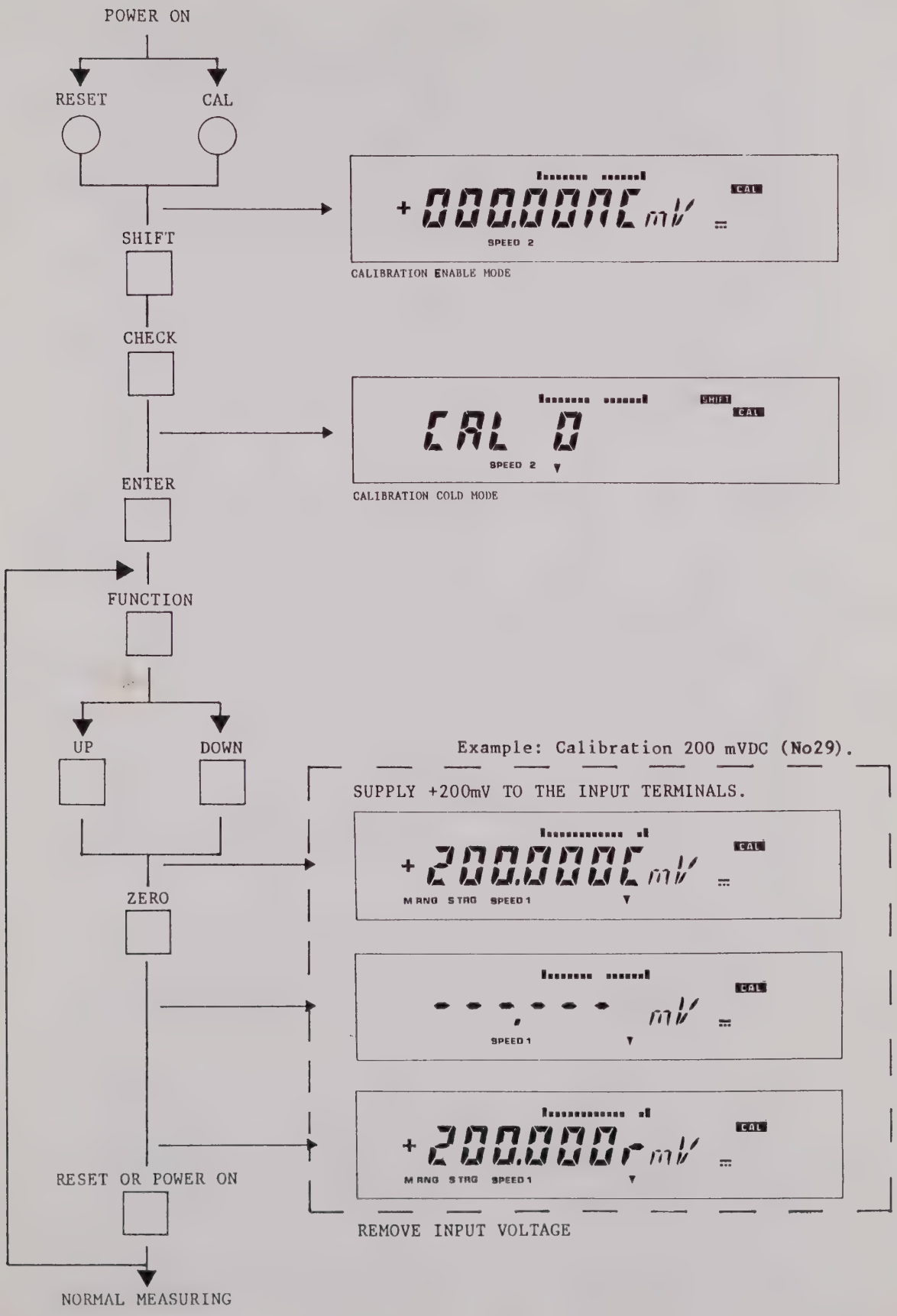
Cold calibration has to be made at a room temperature of +20 to +26°C +/-1°C. Before calibrating the instrument check if the instrument mains frequency is set correct.

How to select the calibration enable mode.

To make it possible to calibrate the instrument it has to be set in the calibration enable mode. This may be done by pressing the switch "CAL" and "RESET"(pencil-point operation) simultaneously and then release the "RESET" switch before releasing the "CAL" switch. Now the instrument is set in the calibration enable mode. In the display CAL appears.Press "SHIFT CHECK 0 ENTER".
Now the instrument is set in the mode "CAL_0" which means calibration cold.
Select the range and function which need to be calibrated.
When the display shows a value followed by "nA" this means, this range cannot be calibrated (not applicable).
After supplying the signal to the input terminals, start calibration by pressing the "ZERO" key. In a few seconds appears on the diplay the calibrated value followed by "r", this means, calibration ready.
If "FAIL" is shown, the calibration has failed and has to be repeated.
Pressing the "RESET" switch or POWER ON/OFF will return to normal measuring.
See also next page: Flowchart for electronic calibration by manual control.



Example of instruments and accessories for cold calibration by manual control.



Flow-chart for electronic calibration by manual control

5.5.2 How to switch on the cold calibration mode by computer control

Cold calibration must be made at a temperature of +20 to +26°C +/- 1°C.
Selecting of range and function must be done by a controller with IEEE-488 interface (IBM compatible e.g. P3100)
When using an PM9181 as IEEE-488 interface for the PM2525, make a help set (see page 5-28) to connect the interface plug and the four wire ohm cable at the same time to the instrument.
Before calibrating the instrument check if the instrument mains frequency is set correct.
To make it possible to calibrate the instrument, it has to be set in the calibration enable mode.
This may be done by pressing the switch "CAL" and "RESET" (pencil-point operation) simultaneouly and then release the "RESET" switch before releasing the "CAL" switch.
Now the instrument is set to the calibration enable mode. In the display "CAL" appears.

COMMANDS

CAL_ON,0	select calibration cold
CAL_OFF	switch off the cal mode,back to cal enable *
CAL_OFF (second)	switch off cal enable mode, back to normal measuring.
CAL_?	gives the actual cal mode (eg CAL ON,0 or CAL OFF)

After sending the command "CAL_ON ,0" the instrument is set in the mode calibration cold.
Now select the range and function which need to be calibrated by sending the corresponding commands.
If the display shows a value followed by "nA " this means this range cannot be calibrated (not applicable).
After supplying the signal to the input terminals, send the command "TRG_B,X". This command will start the calibration.
In a few seconds on the display appears the calibrated value followed by "r ", which means calibration ready.
If "FAIL" is shown the calibration has failed and has to be repeated.
Sending the command "CAL_OFF" once, will set the instrument in the calibration enable mode. Sending the command "CAL_OFF" the second time, the instrument will disable the calibration enable mode and return to normal measuring.
Page 5-20 shows an example of an calibration set-up.
See also page 5-19: Flow-chart calibration by computer control.

* In the calibration enable mode the display shows processed zero point calibration values for test purposes. Refer to chapter 6.3 Trouble shooting.

5.5.3 How to switch on the hot calibration by manual control

Hot calibration have to be made at a temperature of +33 to +40°C +/-5°C. The best way is to do this in an oven.
The warming-up time for hot calibration is one hour (instrument in the oven at the correct temperature, power on).
During calibration,keep the door of the oven closed as much as possible, otherwise there is a lot of temperature loss every time the oven will be opened.

Before calibrating the instrument check if the instrument mains frequency is set correct.

To make it possible to calibrate the instrument, it has to be set in the calibration enable mode.
This may be done by pressing the switch "CAL" and "RESET"(pencil-point operation) simultaneouly and then release the "RESET" switch before releasing the "CAL" switch.
Now the instrument is set in the calibration enable mode. In the display "CAL" appears.

Press "SHIFT CHECK 1 ENTER" and the instrument is set in the mode "CAL 1" which means calibration hot.

Select range and function which need to calibrate, when the display will show a value followed by "nA "this means not applicable.

After supplying the signal to the input terminals press the ZERO key, and calibration is started.
In a few seconds on the display appears the calibrated value followed by "r ", which means calibration ready.
If "FAIL" is shown the calibration has failed and has to be repeated.

Select next function and range and calibrate as above described.

5.5.4 How to switch on the hot calibration by computer control

Hot calibration has to be made at a temperature of +33 to +40°C +/-5°C. The best way is to do this in an oven.
The warming-up time for hot calibration is one hour (instrument in the oven at the correct temperature, power on).
During calibration, keep the door of the oven closed as much as possible, otherwise there is a temperature loss every time the oven will be opened.
Selecting of range and function may by done by controller with a IEEE-488 interface (IBM compatible eg P3100).
When using an PM 9181as IEEE-488 interfacefor the PM2525, make a help set (see page 5-28) to connect the interfase plug and the 4 wire ohm cable at the same time to the instrument.

Before calibrating the instrument check if the instrument mains frequency is set correct.
To make it possible to calibrate the instrument, it has to be set in the calibration enable mode.
This may be done by pressing the switch "CAL" and "RESET" (pencil-point operation) simultaneouly and then release the "RESET" switch before releasing the "CAL" switch.
Now the instrument is set to the calibration enable mode. In the display "CAL" appears.

COMMANDS

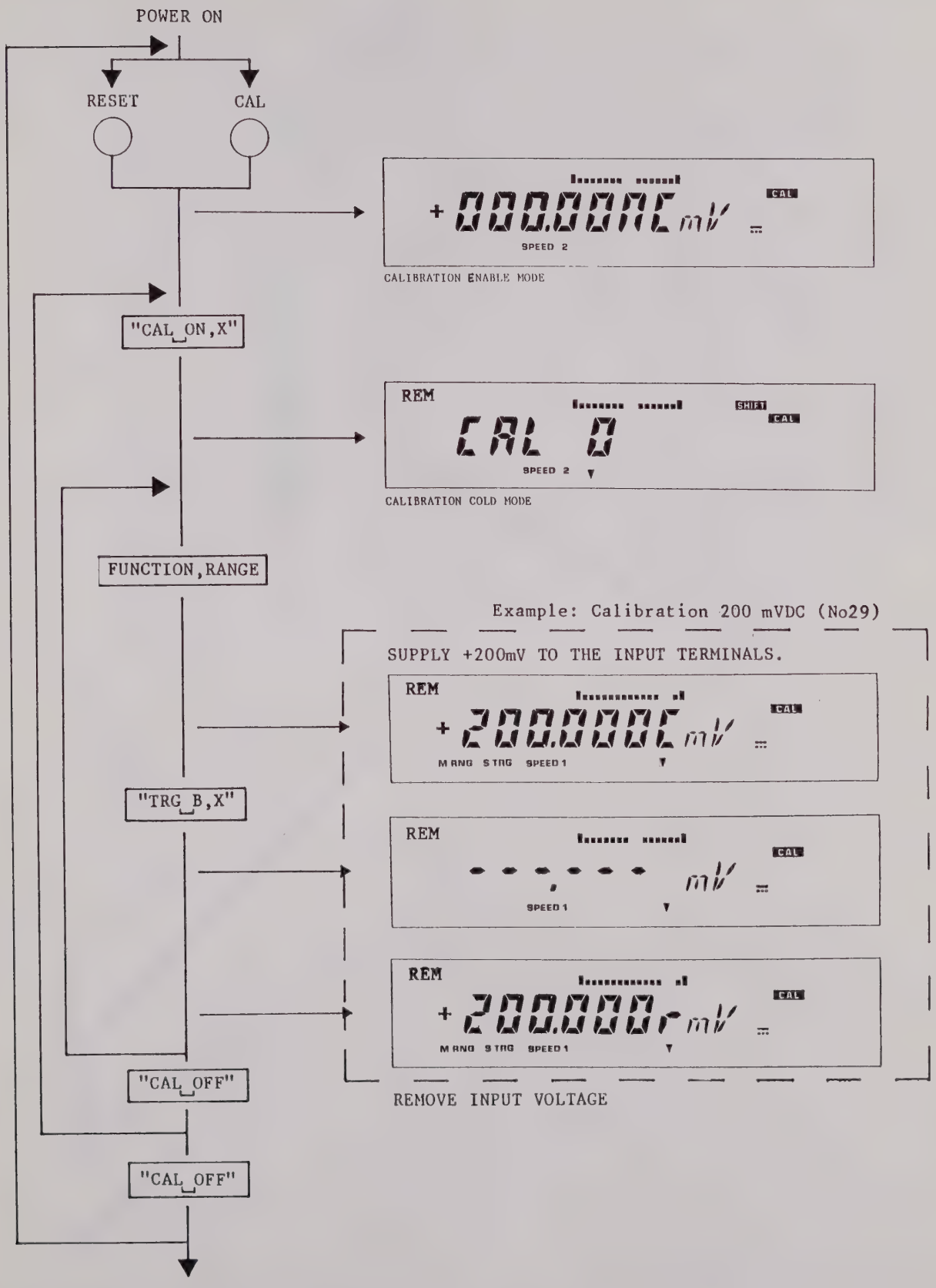
CAL_ON,1	select calibration hot
CAL_OFF	switch off the cal mode,back to cal enable *
CAL_OFF (second)	switch off cal enable mode, back to normal measuring.
CAL_?	gives the actual cal mode (e.g. CAL_0 or CAL_OFF)

After sending the command "CAL_ON,1" the instrument is set in the mode calibration hot.
Now select the range and function which need to calibrated by sending the corresponding commands.
If the display shows a value followed by "nA " this means this range cannot be calibrated (not applicable).

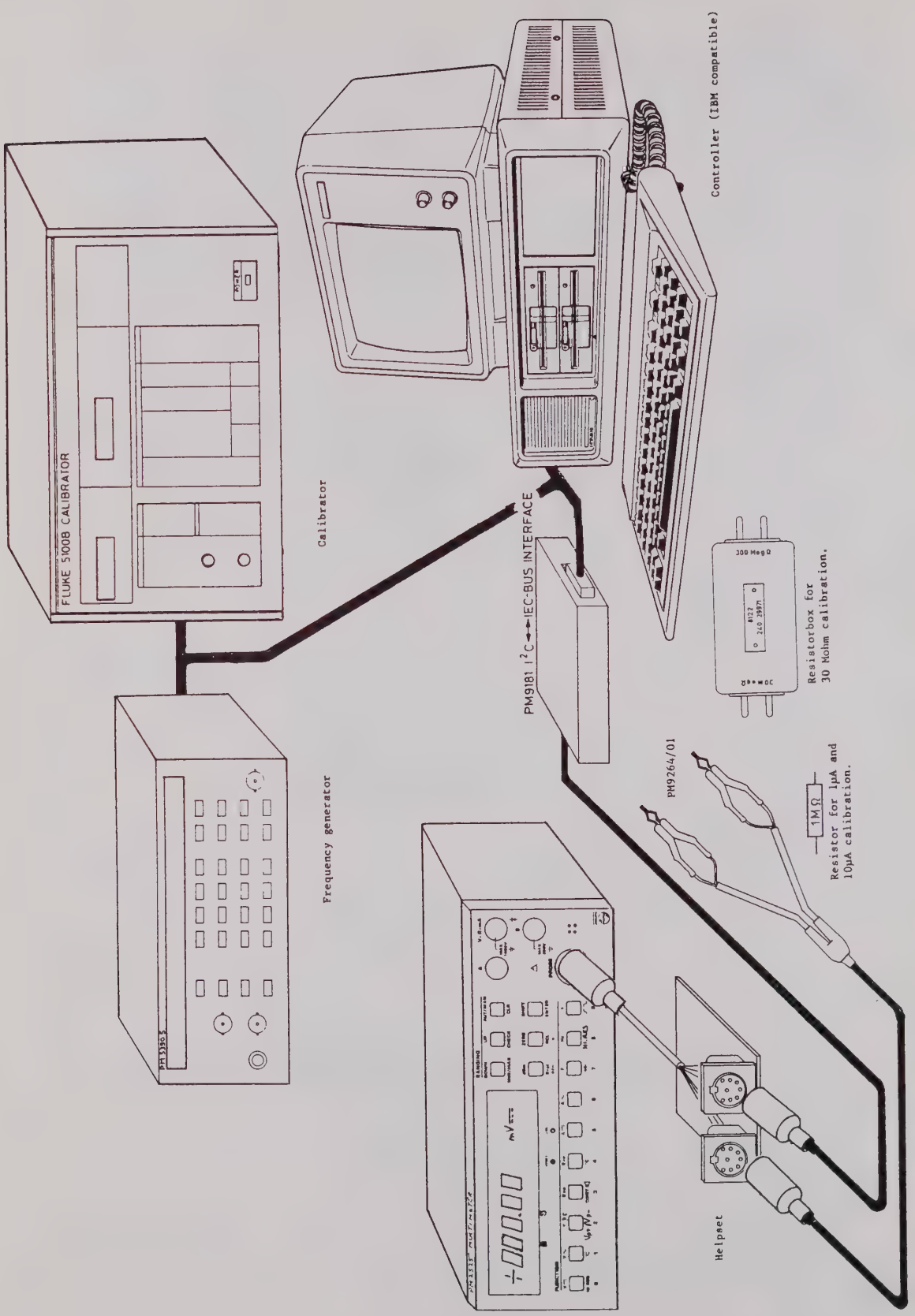
After supplying the signal to the input terminals, send the command "TRG_B,X". This command will start calibration.
In a few seconds appears on the display the calibrated value followed by "r ", which means calibration is OK.
If "FAIL" is shown the calibration has failed and has to be done again.

Sending the command "CAL_OFF" once, the instrument is set in the calibration enable mode. Sending the command "CAL_OFF" the second time, the instrument will disable the calibration enable mode and returns to normal measuring.
See also page 5-19: Flow-chart calibration by computer control.

* In the calibration enable mode the display shows proccessed zero point calibration values for test purposes. Refer to chapter 6.3 Trouble shooting.



Flow-chart for electronic calibration by computer control



Example of instruments and accesories for cold calibration by computer control

5.5.5 Calibration of the 1 uA and 10 uA ranges

The DC current ranges 1 uA and 10 uA of the FLUKE 5100 B calibrator are not accurate enough to calibrate the PM2525
To calibrate these two uA ranges connect a resistor of 1 M between the HI output of the FLUKE 5100 B en the HI input of the PM2525.
Connect the low output of the FLUKE 5100 B to the LO input of the PM2525.
Use undermentioned table for correct input signals.

No	PREPARATION	CALIBRATING RANGE	OUTPUT SIGNAL 5100 B	INPUT SIGNAL PM2525	DISPLAY AFTER CALIBRATION
11		1 uA		open input	0.000 ruA
20	1 MΩ	1 uA	+ 1 V	1 uA	1.0000 ruA
21	1 MΩ	10 uA	+10 V	10 uA	10.000 ruA

Calibration table for DC uA ranges.

5.5.6 Calibration overviews

5.5.6.1 Cold/Hot calibrations

Adj.No	Adj		Cold	Hot
10	1 MHz	f.s.	x	-
11	1 uA DC	zero (open)	x	x
12	100 uA DC	zero (open)	x	x
13	20 nF	zero (open)	x	-
14	200 ΩFW	zero	x	x
15	2 kΩFW	1 kΩ	x	x
16	20 kΩFW	10 kΩ	x	x
17	TDC	0 Ω	x	x
18	TDC	100 Ω	x	x
19	200 MΩTW	30 MΩ	x	x
20	1 uADC	1 uA	x	x
21	10 uADC	10 uA	x	x
22	1 ADC	1 A	x	x
23	200 m VDC	zero	x	x
24	2 VDC	zero	x	x
25	20 VDC	zero	x	x
26	200 VDC	zero	x	x
27	2 VPU	zero	x	x
28	2 VPL	zero	x	x
29	200 mVDC	200 mV	x	x
30	2 VDC	2 V	x	x
31	20 VDC	20 V	x	x
32	20 VDC	-20 V	x	-
33	2 VPU	2 V	x	x
34	2 VPL	-2 V	x	x
35	200 mVAC	200 mV	x	-
36	2-VAC	2 V	x	x
37	20 VAC	20 V	x	-
38	200 kΩ	100 kΩ	x	x
39	2 MΩ	1 MΩ	x	x
40	20 MΩ	10 MΩ	x	x
41	1 mADC	1 mA	x	x
42	100 mADC	100 mA	x	x
43	1 mAAC	1 mA	x	x
44	200 VAC	200 V	x	-
45	2000 VAC	600 V	x	-
46	200 VDC	200 V	x	-
47	2000 VDC	1000 V	x	-

5.5.6.2 Calibration cross-reference of related ranges

Nr.	Function	Range	Cold Zero scale	Cold Full scale	Hot Zero scale	Hot Full scale
23/29	VDC	200 mV	x	x	x	x
24/30	VDC	2 V	x	x	x	x
25/31	VDC	20 V	x	x	x	x
32	VDC	-20 V	.	x	.	.
26/46	VDC	200 V	x	x	x	.
47	VDC	2000 V	.	x!	.	.
35	VAC	200 mV	.	x	.	.
36	VAC	2 V	.	x	.	x
37	VAC	20 V	.	x	.	.
38	VAC	200 V	.	x	.	.
45	VAC	2000 V	.	x!	.	.
28/34	VPL	2 V	x	x	x	x
2733	VPU	2 V	x	x	x	x

! Input value is not full scale.

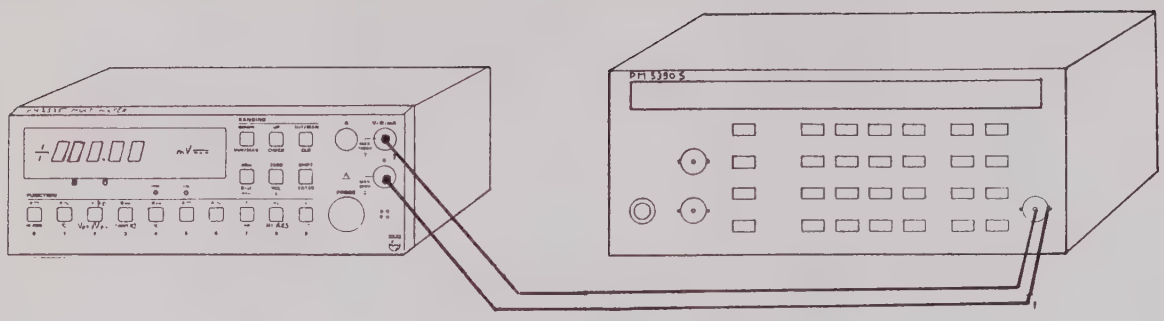
Nr.	Function	Range	Cold Zero scale	Cold Full scale	Hot Zero scale	Hot Full scale
14	RFW	200Ω	x	.	x	.
15	RFW	2 kΩ	.	x!	.	x!
16	RFW	20 kΩ	.	x!	.	x!
38	RTW	200 kΩ	.	x!	.	x!
39	RTW	2 MΩ	.	x!	.	x!
40	RTW	20 MΩ	.	x!	.	x!
19	RTW	200 MΩ	.	x!	.	x!
17/18	TDC	-100. +850°C	x	x!	x	x
11/20	IDC	1 uA	x	x	x	x
21	IDC	10 uA	.	x	.	x
12	IDC	100 uA	x	.	x	.
41	IDC	1 mA	.	x	.	x
42	IDC	100 mA	.	x	.	x
22	IDC	1 A	.	x	.	x
43	IAC	1 mA	.	x	.	x
13	CAP	20 nF	x	.	.	.

! Input value is not full scale.

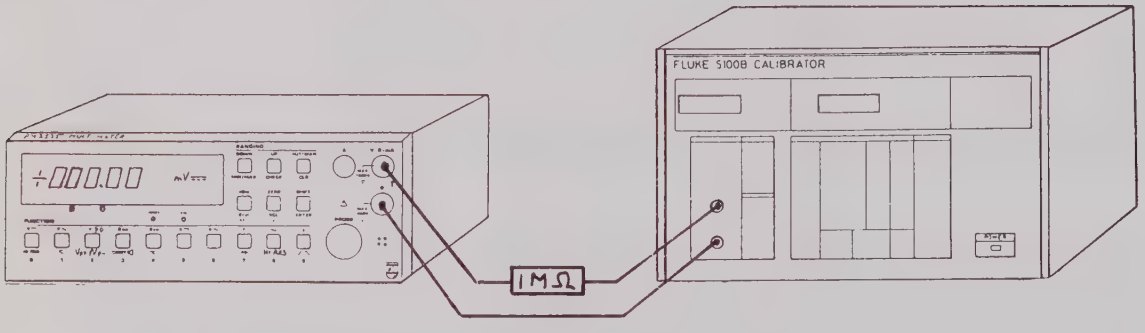
5.5.7 Calibrationtable

Nr.	Function	Range	Input signal	Display before calibration	Display before calibration	Remarks
10*	Hz (only cold)	1 MHz	1 MHz 2 Vpp +/- 2 Hz	1.00000 CMHz	1.00000 rMHz	
11	IDC	1 uA	open input	1.0000 CuA	0.0000 ruA	
12	IDC	100 uA	open input	100.00 CuA	000.00 ruA	
13*	F (only cold)	20 nF	open input	20.000 CnF	00.000 rnF	
14	RFW	200Ω	0Ω	200.00 CΩ	000.00 rΩ	Use 4 wire cable
15	RFW	2 kΩ	1 kΩ +/- 0.04 %	1.0000 CkΩ	1.0000 rkΩ	Use 4 wire cable
16	RFW	20 kΩ	10 kΩ +/- 0.04 %	10.000 CkΩ	10.000 rkΩ	Use 4 wire cable
17	TDCΩ	0	0Ω	000.0 C°C	-246.8 r°C	Use 4 wire cable
18	TDCΩ	100	100Ω +/- 0.1 %	000.0 C°C	000.0 r°C	Use 4 wire cable
19	RTW	200 MΩ	30 MΩ +/- 1.66 %	30.0 CMΩ	30.0 rMΩ	See section 5.5.7
20	IDC	1 uA	1 uA ⎓ +/- 0.03 %	1.0000 CuA	1.0000 ruA	See section 5.5.4
21	IDC	10 uA	10 uA ⎓ +/- 0.03 %	10.000 CuA	10.000 ruA	See section 5.5.4
22	IDC	1 A	1 A ⎓ +/- 0.03 %	1.0000 C A	1.0000 rA	
23	VDC	200 mV	0	200.000 CmV	000.000 rmV	
24	VDC	2 V	0	2.00000 CV	0.00000 rV	
25	VDC	20 V	0	20.0000 CV	00.0000 rV	
26	VDC	200 V	0	200.000 CV	000.000 rV	
27	VPU	2 V	0	2.000 CVP^	0.000 rVP^	
28	VPL	2 V	0	2.000 CVP˘	0.000 rVP˘	
29	VDC	200 mV	200 mV ⎓ +/- 0.006 %	200.000 CmV	+200.000 rmV	
30	VDC	2 V	2 V ⎓ +/- 0.006 %	2.00000 CV	+2.00000 rV	
31	VDC	20 V	20 V ⎓	20.0000 CV	+20.0000 rV	

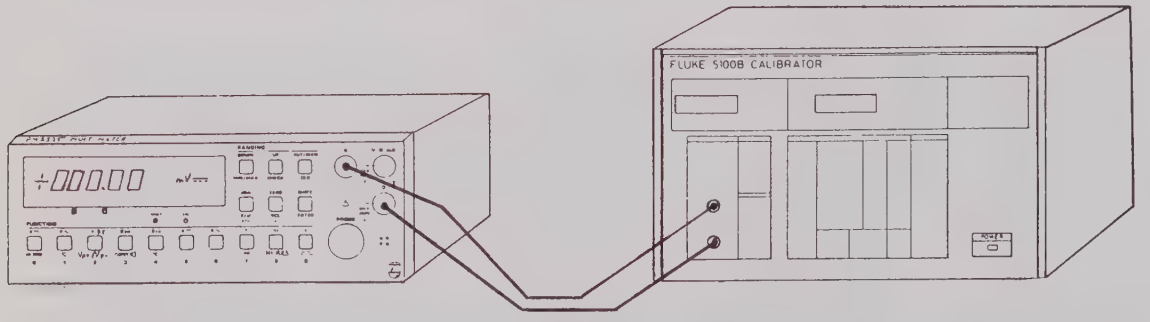
Nr.	Function	Range	Input signal	Display before calibration	Display before calibration	Remarks
32*	VDC (only cold)	20 V	-20 V ⎓ +/- 0.006 %	20.0000 CV	-20.0000 rV	
33	VPU	2 V	2 V ⎓ +/- 0.3 %	2.000 CVP	2.000 rVP	
34	VPL	2 V	-2 V ⎓ +/- 0.3 %	2.000 CVP˘	2.000 rVP˘	
35*	VAC (only cold)	200 mV	200 mV 60 Hz +/- 0.08 %	200.00 CmV~	200.00 rmV~	
36	VAC	2 V	2 V 60 Hz +/- 0.08 %	2.0000 CV~	2.0000 rV~	
37*	VAC (only cold)	20 V	20 V 60 Hz +/- 0.08 %	20.000 CV~	20.000 rV~	
38	RTW	200 kΩ	100 kΩ +/- 0.04 %	100.00 CkΩ	100.00 rkΩ	
39	RTW	2 MΩ	1 MΩ +/- 0.14 %	1.0000 CMΩ	1.0000 rMΩ	
40	RTW	20 MΩ	10 MΩ +/- 0.14 %	10.000 CMΩ	10.000 rMΩ	
41	IDC	1 mA	1 mA ⎓ +/- 0.03 %	1.0000 CmA	1.0000 rmA	
42	IDC	100 mA	100 mA +/- 0.03 %	100.00 CmA	100.00 rmA	
43	IAC	1 mA	1 mA 60 Hz +/- 0.11 %	1.0000 CmA	1.0000 rmA	
44	VAC	200 V	200 V 60 Hz +/- 0.08 %	200.00 CV	200.00 rV	
45*	VAC (only cold)	2000 V	600 V 60 Hz +/- 0.1266	0600.0 CV	0600.0 rV	
46*	VDC (only cold)	200 V	200 V ⎓ +/- 0.006 %	200.000 CV	200.000 rV	
47*	VDC (only cold)	2000 V	1000 V ⎓ +/- 0.008 %	1000.00 CV	1000.00 rV	



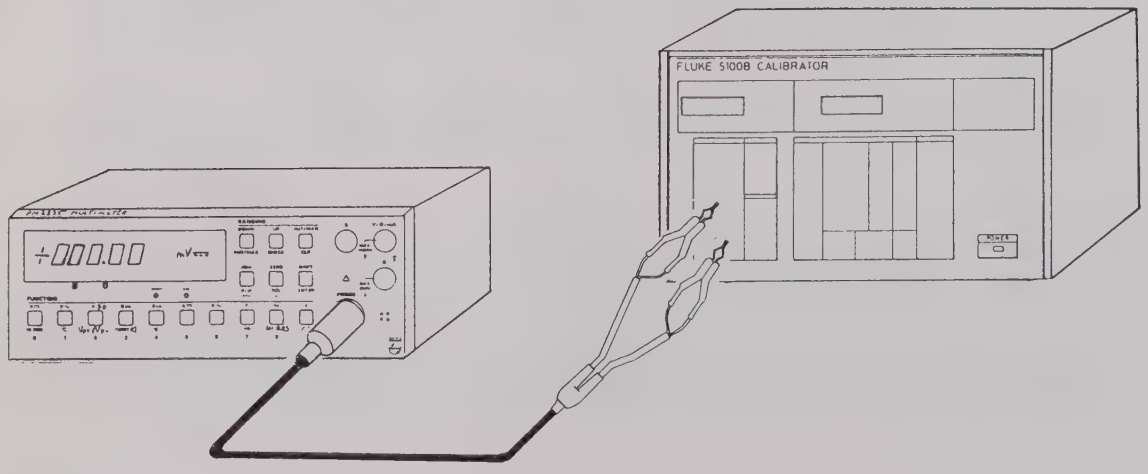
Example of calibration set up for Hz



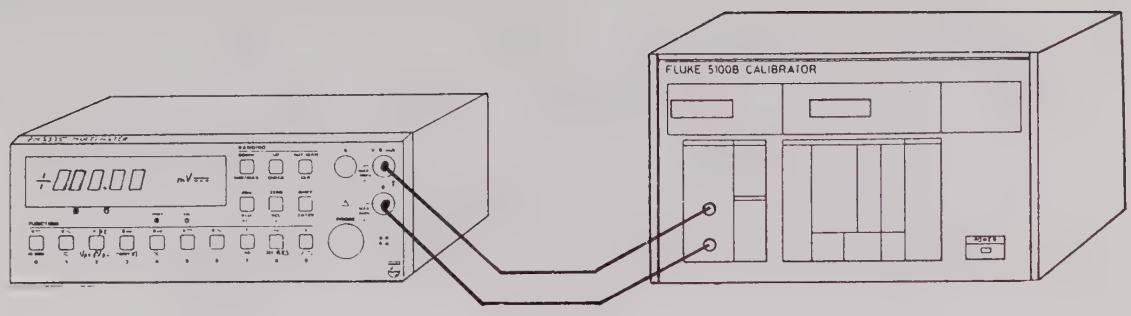
Example of calibration set up for 1 ua DC and 10 ua DC



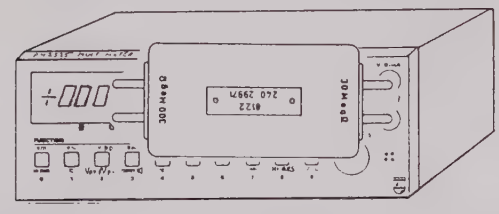
Example of calibration set up for 1 A DC



Example of calibration set up for RFW and TDC



Example of calibration set up for VDC,VP+,VP-,VAC,RTW,IAC and some ranges of IDC



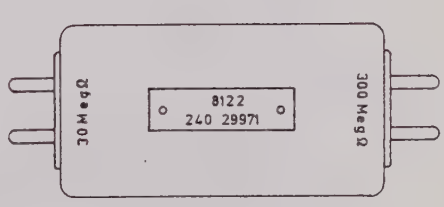
Example of calibration set up for RTW 30 M

5.5.8 Calibration accesories

A resistor box* is availeble for calibrating the 30 M range of the PM2525.

Characteristics

Accuracy 30 MΩ	:0.04%
Accuracy 300 MΩ	:0.16%
Reference temperature	:+23 +/-1°C
Relative humidity	:20 - 80 %
Recalibration interval	:6 months



Resistorbox for 30 Mohm calibration.

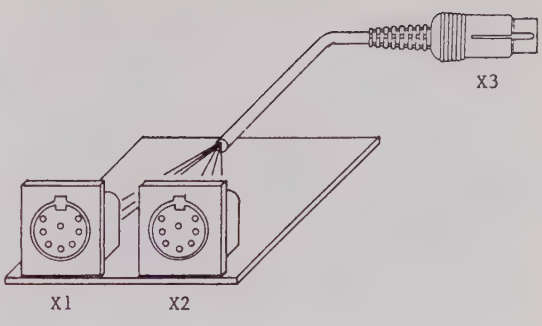
The adjusting resistors to calibrate the resistors box can be attained by removing the cover of it.

NOTE: Connect the resistor box in the correct way (V-Ω pin in the V-Ω terminal). this will eliminate the influence of hancontact etc. on the calibration measurements.

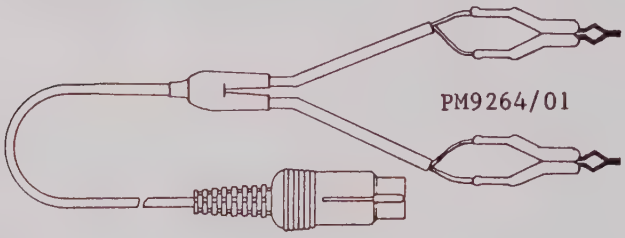
* Available at service T&M, I&E Almelo Holland ordering number 8122 240 29971

Connections of the help set

pin 1 of X3 to pin 1 of X1 and X2
pin 2 of X3 to pin 2 of X1 and X2
pin 3 of X3 to pin 3 of X1 and X2
pin 4 of X3 to pin 4 of X1 and X2
pin 5 of X3 to pin 5 of X1 and X2
pin 6 of X3 to pin 6 of X1 and X2
pin 7 of X3 to pin 7 of X1 and X2
pin 8 of X3 to pin 8 of X1 and X2



Helpset



Measuring cable for RFW (Resistance Four Wire) and TDC (Temperature Degree Celcius).

5.6 ADJUSTING THE LIQUID CRYSTAL DISPLAY

The PCF 8576 is a circuit designed to drive a Liquid Crystal Display with up to 160 segments. A 2-line IIC bus structure enables serial data transfer with the microcomputer.
A LCD is a AC device. Therefore, for multiplexing, the information of the segment line is important for each segment that will be driven by thet line.
The reference voltage for the driver is obtained from transistor V 2102 and zener diode V 1201.
To change the viewing angle the reference voltage can be adjusted with potentiometer R 5102.

6. CORRECTIVE MAINTENANCE

6.1 SPECIAL PARTS

In addition to the standard electronic components, some special components are used:
- Components, manufactured or selected by Philips to meet specific performance requirements.
- Components which are important for the safety of the instrument.

ATTENTION: Both type of components may only be replaced by components obtained through your local Philips organisation or representative. These components have been marked in the Parts List by a *.

6.2 TROUBLESHOOTING

BUILT IN TESTS

TEST 1 Direct measuring mode without processing of the measuring results.

Description: In the normal measuring mode the measuring results are processed.
In the direct measuring mode the following process functions are left out.
- Calibration values are not processed.

Remark: The measuring result is not accurate.

- No auto zero of the analog to digital convertor. Signal AZC (A1203/13) on the ADC is not active.
- No offset control of the pre-amplifier/bufffer (signal OVCP A1201/22) and offset control of the RMS-convertor (signal A1201/23).
- No measuring of the internal temperature after xmeasurements.
  The internal temperature is measured in the Vpeak configuration via transistor V1500.

How to switch on the test: Press push button S1701 while measuring.
The switch is situated on the mother board (little white knob).

When to use the test: Use the test when the PM2525 has a hang-up.
All the important conditional jumps are skipped.

TEST 2 Show deviation in processed zero point calibration values.

Description : At shortcicuited input the PM2525 will show the processed zero point calibration values. These values may have positive or negative polarity sign, also for not polarity related functions such as function OHM.
Example: Suppose the zero point of OHM is calibrated with +10 digits due to a bad connection, and this is accepted by the PM2525 (calibration passed) In the normal measuring mode this +10 digits is calculated in the measuring result and not shown. In TEST 2 the PM2525 does not calculate with the zero point calibration value.
At a correct zero point connection the display will show in this case -10 digits in thefunction OHM.

How to switch: The test is active in the CALibration enable mode.
on the test With the two switches on the front (CAL and RESET) the CALibration enable mode is switched on.

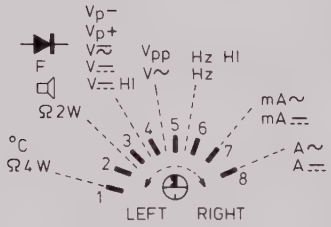
WARNING: DONOT USE THE MEASURING RESULTS IN THE CALIBRATION ENABLE MODE AS NORMAL MEASURING RESULTS FOR E.G. A CALIBRATION LIST PRINT-OUT.

When to use : Alinearity errors may be caused by a incorrect zero
the test. point calibration. Test 2 allows to trace this.

Alinearity may be caused in the following functions: OHM-2W, OHM-4W, Vp+, Vp-, Vpp, F, Vac, Vac+dc, Aac.

TEST 3 Testing the motor circuit

FUNCTION	SWITCH CONTACT		NAME	SWITCH CONTACT
Hz, Hz HI RES	I1		FHRZ	5-6
V~, Vpp	I5		FVAC	4-5
V⎓, V⎓ HI RES	I6		FVDC	3-4
V≂, Vp+, Vp−, S				
Ω 2W, ◁), F, ▶|	I9, I10	U4	FRTW	2-3
Ω 4W, °C	I8, I11	U4	FRFW	1
A~, A⎓	I3, I4	U1	FIHI	8
mA~, mA⎓	I2	U1	FILO	7



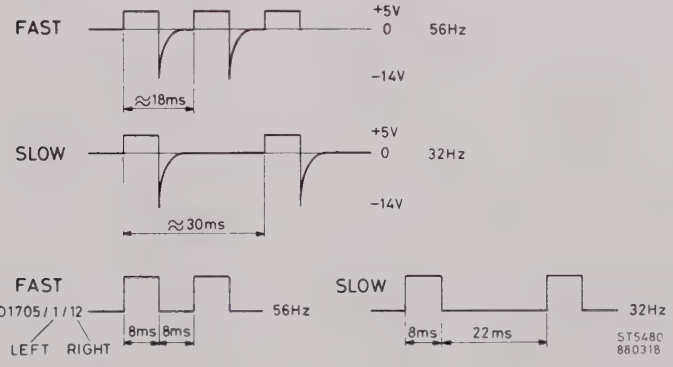
MOTOR SWITCH POSITION

ST5470
880311

The motor can run on two speeds:

SPEED 1 = FAR FROM THE SELECTED FUNCTION
SPEED 2 = CLOSE TO THE DESIRED FUNCTION

If the motor is forced by hand to the left, it will try to run to the left.
If far from the selected function: (Measured on motor RED=HI, BLUE=LO)



7. SAFETY IN SPECTION TESTS AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT

7.1 GENERAL DIRECTIVES

- Take care that the creepage distance and clearances have not been reduced.
- Before soldering, the wires should be bent through the holes of solder tags, or wrapped around the tag in the form of an open U, or Wiring ridigity shall be maintained by cable clamps or cable lacing.
- Replace all insulating guards and plates.

7.2 SAFETY COMPONENTS

Components in the primary circuit may only be replaced by components selected by Philips.

7.3 CHECKING THE PROTECTIVE EARTH CONNECTION

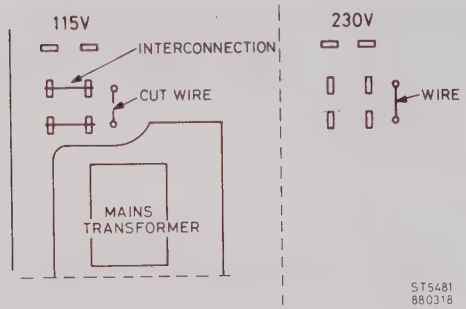
The correct connection and condition is checked by visual control and by measuring the resistance between the protective lead connection at the plug and the cabinet/frame. The resistance shall not be more than 0,5 Ohm. During measurements the mains cable should be removed. Resistance varations indicate a defect.

7.4 ADAPTION TO THE LOCAL MAINS VOLTAGE (115/230V)

The PM2525 can be altered to another mains voltage.
To alter proceed as follows:

- Remove the topcover and top screening (Refer to chapter 4)

Place jumpers and short-circuitwire in the correct position.



Remark: For both 115 V and 230 V the same mains fuse can be used. 630 mAT/250 V DIN 41571.

7.5 ADAPTION TO THE LOCAL MAINS FREQUENCY (50/60 Hz)

In the "CHECK" function the instrument can be adapted to the local mains frequency.

Proceed as follows:

50 Hz to 60 Hz

Press	SHIFT CHECK	1	ENTER
Display action	60 H0	60 H1	Measuring

60 Hz to 50 Hz

Press	SHIFT CHECK	0	ENTER
Display action	60 H1	60 H0	Measuring

8. PARTS LIST

8.1 MECHANICAL

(/01/21/51/61/71)	EUROPE
(/013/213/513/613/713)	USA
(/014/214/514/614/714)	United Kingdom
(/015/215/515/615/715)	Zwitzerland

Fuse holder A-function	5322 256 34102
Fuse holder A-function p.c. board part	5322 462 44478
Fuse 630 mAT for A-function -mains	4822 253 30018
Display cable 7-pole	5322 321 22602
Foot (4x)	5322 462 41201
Distance piece (1) plastic (4x)	5322 535 92416
Window	5322 450 60633
LCD interconnection rubber	5322 267 50753
Liquid crystal display	5322 130 90454
Rotor insulation	5322 466 91519
Slide rotor assembly	5322 362 20226
Rotor clip ring	5322 532 60932
P.c. board ring	5322 532 51932
Motor gear-wheel	5322 522 32384
Gear wheel	5322 525 32463
Motor	5322 361 21036
IC socket 28 pins	5322 255 44047
IC socket 40 pins	5322 255 44217
Thermal fuse for transformers	5322 252 20117
Mains transformer	5322 242 71888
Secondary transformer	5322 146 10241
Wiring with coil for mains entrance	5322 321 22837
IEEE p.c. board	5322 218 61099
Galvanic separation p.c. board	5322 218 61098
Resonator 650 kHz	5322 242 71888
Mains input socket	5322 265 20372

8.2 MECHANICAL

(/01/21/51/61/71) EUROPE

(/014/214/514/614/714) United Kingdom

(/015/215/515/615/715) Switzerland

Pushbutton knob dark (15x)	5322 414 20031
Pushbutton knob light (1x)	5322 414 60146
Handle arm assembly	5322 498 54105
Bottom cover assembly (incl. screening, feet, screws)	5322 447 91447
Front assembly (incl. textplate, input block)	5322 447 91446
Top cover assembly (incl. screening, distance pieces)	5322 447 91527

8.3 MECHANICAL

(/013/213/513/613/713) USA

Knob light (10x)	5322 414 20243
Knob grey (5x)	5322 414 20244
Knob black (1x)	5322 414 20245
Handle assembly	5322 498 50262
Front assembly (incl. textplate, input block)	5322 447 91524
Bottom cover assembly (incl. screening, feet, screws)	5322 447 91525
Top cover assembly (incl. screening, distance pieces)	5322 447 91528

8.4 ELECTRICAL /01./51. N0300, N0600, N1000, N2200 (.=empty, 3, 4, 5)

N0300 = Galvanic separation
N0400 = Battery p.c. board
N0600 = IEEE-488 p.c. board
N1000 = Motherboard
N2200 = Display p.c. board
N11000 = RS232 p.c. board
N21000 = Analog output p.c. board

RA10	NETWORK 33K SPECIAL	5322 111 91617
D1201	OQ302	5322 209 11657
R1100	NETWORK OM551	5322 209 72563
D1710	ROM	5322 209 50563

A 1203	OQ0067A	5322 209 81883
C 0301	10V 20% 10UF	5322 124 21956
C 0303	-20+50% 10NF	4822 122 31414
C 0304	-20+50% 10NF	4822 122 31414
C 0307	-20+50% 10NF	4822 122 31414
C 0309	-20+50% 10NF	4822 122 31414
C 0310	25V 20% 1UF	5322 124 21959
C 0311	25V 20% 1UF	5322 124 21959
C 0312	10V 20% 10UF	5322 124 21956
C 0313	-20+20% 4700UF	5322 124 21504
C 0314	63V 10% 100NF	5322 121 42386
C 0320	20% 400V 1NF	5322 122 40364
C 0321	20% 400V 1NF	5322 122 40364
C 0322	-20+50% 10NF	4822 122 31414
C 0323	-20+50% 10NF	4822 122 31414
C 0324	-20+50% 10NF	4822 122 31414
C 0325	-20+50% 10NF	4822 122 31414
C 0601	6,3V 20% 22UF	4822 124 20943
C 0602	25V 20% 1UF	5322 124 21959
C 0603	6,3V 20% 22UF	4822 124 20943
C 0604	-20+50% 10NF	4822 122 31414
C 0605	-20+50% 10NF	4822 122 31414
C 0606	-20+50% 10NF	4822 122 31414
C 0607	6,3V 20% 22UF	4822 124 20943
C 0608	2% 33PF	5322 122 32072
C 0609	2% 33PF	5322 122 32072
C 1101	400V 10% 33NF	5322 121 44025

POSNR	DESCRIPTION	ORDERING CODE
C 1102	630V 1% 110PF	5322 121 54058
C 1103	630V 1% 120PF	4822 121 50548
C 1104	2% 33PF	5322 122 32072
C 1105	F 160V	5322 125 50352
C 1106	0.25PF 3.9PF	5322 122 34107
C 1107	250V 1% 1NF	4822 121 50566
C 1108	300V	5322 125 50058
C 1109	2% 27PF	4822 122 30045
C 1110	63V 1% 11NF	5322 121 54147
C 1111	300V	5322 125 50058
C 1112	2% 27PF	4822 122 30045
C 1113	2% 56PF	4822 122 32027
C 1114	2% 120PF	4822 122 31348
C 1115	63V 10% 100NF	5322 121 42386
C 1116	-20+50% 10NF	4822 122 31414
C 1117	10% 470PF	4822 122 30034
C 1118	2% 56PF	4822 122 32027
C 1119	2% 220PF	5322 122 34047
C 1120	10% 4.7NF	4822 122 31125
C 1200	2% 220PF	5322 122 34047
C 1201	63V 1% 11NF	5322 121 54147
C 1202	2% 100PF	4822 122 31316
C 1203	63V 10% 470NF	5322 121 42467
C 1204	63V 10% 100NF	5322 121 42386
C 1205	2% 390PF	4822 122 32121
C 1206	2% 390PF	4822 122 32121
C 1207	63V 10% 47NF	5322 121 42604
C 1208	2% 47PF	4822 122 31072
C 1209	2% 33PF	5322 122 32072
C 1210	2% 10PF	4822 122 32185
C 1211	2% 33PF	5322 122 32072
C 1212	-20+50% 10NF	4822 122 31414
C 1213	-20+50% 10NF	4822 122 31414
C 1214	-20+50% 10NF	4822 122 31414
C 1215	63V 10% 470NF	5322 121 42467
C 1216	63V 10% 470NF	5322 121 42467
C 1217	-20+50% 10NF	4822 122 31414
C 1218	2% 100PF	4822 122 31316
C 1219	63V 10% 680NF	5322 121 42498
C 1220	63V 10% 680NF	5322 121 42498
C 1221	10% 1NF	4822 122 30027
C 1222	0.25PF 2.7PF	4822 122 31038
C 1223	10% 1NF	4822 122 30027
C 1224	10% 1NF	4822 122 30027
C 1225	-20+50% 10NF	4822 122 31414
C 1226	-20+50% 10NF	4822 122 31414
C 1227	10% 2.2NF	4822 122 30114
C 1301	400V 10% 10NF	5322 121 41977
C 1302	-20+20% 1UF	5322 124 41098
C 1303	63V 10% 100NF	5322 121 42386
C 1304	2% 330PF	5322 122 32704
C 1305	-20+50% 10NF	4822 122 31414
C 1306	-20+20% 100UF	5322 124 41383
C 1401	10% 1NF	5322 122 32127
C 1402	-20+50% 10NF	4822 122 31414
C 1404	-20+20% 33UF	5322 124 41378
C 1405	-20+20% 33UF	5322 124 41378
C 1407	-20+20% 100UF	5322 124 41383
C 1408	-20+20% 33UF	5322 124 41378
C 1409	-20+50% 10NF	4822 122 31414
C 1410	-20+50% 10NF	4822 122 31414
C 1411	-20+50% 10NF	4822 122 31414
C 1500	-20+50% 10NF	4822 122 31414
C 1501	10% 1NF	5322 122 32127
C 1502	100V 10% 10NF	4822 121 41857

POSNR	DESCRIPTION	ORDERING CODE
C 1503	100V 5% 4.7UF	4822 121 41975
C 1504	10% 1NF	4822 122 30027
C 1505	63V 10% 1UF	5322 121 42114
C 1506	-20+50% 10NF	4822 122 31414
C 1507	-20+50% 10NF	4822 122 31414
C 1508	-20+50% 10NF	4822 122 31414
C 1509	-20+50% 10NF	4822 122 31414
C 1510	0.25PF 4.7PF	4822 122 31822
C 1511	2% 220PF	5322 122 34047
C 1512	2% 100PF	4822 122 31316
C 1513	-20+50% 10NF	4822 122 31414
C 1514	-20+50% 10NF	4822 122 31414
C 1602	-10+50% 330UF	4822 124 20705
C 1603	-20+50% 10NF	4822 122 31414
C 1604	-20+20% 1UF	5322 124 41098
C 1605	-10+50% 330UF	4822 124 20705
C 1606	-20+50% 10NF	4822 122 31414
C 1607	-20+20% 1UF	5322 124 41098
C 1609	-20+20% 10000UF	5322 124 22332
C 1611	-10+50% 470UF	4822 124 20695
C 1612	10% 1NF	4822 122 30027
C 1613	10% 1NF	4822 122 30027
C 1614	10% 1NF	4822 122 30027
C 1615	10% 1NF	4822 122 30027
C 1616	10% 1NF	4822 122 30027
C 1617	10% 1NF	4822 122 30027
C 1618	10% 1NF	4822 122 30027
C 1619	10% 1NF	4822 122 30027
C 1701	10V 20% 10UF	5322 124 21956
C 1702	10% 1NF	4822 122 30027
C 1703	-20+20% 10UF	5322 124 21731
C 1704	2% 33PF	5322 122 32072
C 1705	2% 33PF	5322 122 32072
C 1706	-20+20% 10UF	5322 124 21731
C 1707	-20+50% 10NF	4822 122 31414
C 1708	2% 100PF	4822 122 31316
C 1709	2% 100PF	4822 122 31316
C 1710	10% 1NF	4822 122 30027
C 1711	-20+50% 10NF	4822 122 31414
C 1712	-20+20% 1UF	5322 124 41098
C 1713	-20+20% 10UF	5322 124 21731
C 1714	-20+50% 10NF	4822 122 31414
C 1715	-20+50% 10NF	4822 122 31414
C 1717	-20+50% 10NF	4822 122 31414
C 1718	-20+50% 10NF	4822 122 31414
C 1719	-20+50% 10NF	4822 122 31414
C 1720	-20+50% 10NF	4822 122 31414
C 1721	-20+50% 10NF	4822 122 31414
C 1722	-20+50% 10NF	4822 122 31414
C 1723	-20+50% 10NF	4822 122 31414
C 1724	-20+50% 10NF	4822 122 31414
C 1725	-20+50% 10NF	4822 122 31414
C 1726	-20+50% 10NF	4822 122 31414
C 1727	-20+50% 10NF	4822 122 31414
C 1728	2% 47PF	4822 122 31072
C 1729	-20+50% 10NF	4822 122 31414
C 1730	-20+50% 10NF	4822 122 31414
C 1731	10% 1NF	4822 122 30027
C 1732	63V 10% 100NF	5322 121 42386
C 1733	-20+50% 10NF	4822 122 31414
C 1734	-20+50% 10NF	4822 122 31414
C 1735	-20+50% 10NF	4822 122 31414
C 2101	-20+80% 22NF	4822 122 30103
C 2102	-20+80% 22NF	4822 122 30103

POSNR	DESCRIPTION		ORDERING CODE
D 0601	MAF8441PT008		5322 209 11131
D 0602	SN75161AN	T.I	5322 209 81842
D 0603	SN75160AN	T.I	5322 209 81807
D 0605	SN74LS02N	T.I	5322 209 85312
D 0606	SN74LS05N	T.I	5322 209 84994
D 1701	PC74HC132P	PEL	5322 209 11194
D 1703	PC74HC132P	PEL	5322 209 11194
D 1704	PC74HC86P	PEL	4822 209 11426
D 1705	PC74HC27P	PEL	5322 209 11333
D 1706	P8031AH	INT	5322 209 11128
D 1707	PC74HC165P	PEL	5322 209 11531
D 1709	PC74HC373P	PEL	5322 209 11366
D 1711	CDM6116AE2	RCA	5322 209 83103
D 1712	PC74HC4094P	PEL	5322 209 11532
D 1713	PC74HC4094P	PEL	5322 209 11532
D 1714	OQ0071		5322 209 81901
D 2101	PCF8576T	PEL	5322 209 11129
D 2201	PCF8574P	PEL	5322 209 10883
F 0001	T 5X20 630MA		4822 253 30018
F 0002	T 5X20 630MA		4822 253 30018
G 0601	6000,000KHZ		4822 242 70392
G 1701	UNIT 12000 KHZ		5322 242 71226
H 0301	CNX36	PEL	5322 130 90097
H 0302	CNX36	PEL	5322 130 90097
H 0303	CNX36	PEL	5322 130 90097
H 0304	CNX36	PEL	5322 130 90097
H 0305	CNX36	PEL	5322 130 90097
H 0306	CNX36	PEL	5322 130 90097
H 0307	CNX36	PEL	5322 130 90097
H 0308	CNX36	PEL	5322 130 90097
H 0309	CNX36	PEL	5322 130 90097
H 0310	CNX36	PEL	5322 130 90097
H 1701	PS20-01-0		5322 280 10148
L 1701	27UH		4822 158 10551
N 0301	LM393N	NSC	4822 209 80797
N 0302	LM393N	NSC	4822 209 80797
N 0303	LM393N	NSC	4822 209 80797
N 0321	UA7805UC	FSC	5322 209 84841
N 1202	NE5532P	T.I	5322 209 83339
N 1301	OP-07CZ	PMI	5322 209 83268
N 1501	LF444CN	NSC	5322 209 71975
N 1502	LM311N	NSC	5322 209 85503
N 1601	LM78L05ACZ	N.S	5322 209 80903
N 1602	LM79L05ACZ	NSC	5322 209 86434
N 1603	LM358N	N.S	4822 209 70672
R 0301	MRS25 1% 2K49		5322 116 53574
R 0302	MRS25 1% 3K65		5322 116 53245
R 0303	MRS25 1% 3K65		5322 116 53245
R 0304	MRS25 1% 3K65		5322 116 53245
R 0305	MRS25 1% 2K49		5322 116 53574
R 0307	MRS25 1% 8K25		5322 116 53267
R 0308	MRS25 1% 287E		5322 116 53221
R 0309	MRS25 1% 100E		5322 116 53126
R 0310	MRS25 1% 287E		5322 116 53221
R 0311	MRS25 1% 100E		5322 116 53126
R 0312	MRS25 1% 8K25		5322 116 53267

POSNR	DESCRIPTION	ORDERING CODE
R 0314	MRS25 1% 2K49	5322 116 53574
R 0315	MRS25 1% 3K65	5322 116 53245
R 0316	MRS25 1% 3K65	5322 116 53245
R 0317	MRS25 1% 2K49	5322 116 53574
R 0318	MRS25 1% 3K65	5322 116 53245
R 0319	MRS25 1% 2K49	5322 116 53574
R 0320	MRS25 1% 3K65	5322 116 53245
R 0321	MRS25 1% 3K65	5322 116 53245
R 0322	MRS25 1% 3K65	5322 116 53245
R 0323	MRS25 1% 2K49	5322 116 53574
R 0325	MRS25 1% 8K25	5322 116 53267
R 0326	MRS25 1% 287E	5322 116 53221
R 0327	MRS25 1% 100E	5322 116 53126
R 0329	MRS25 1% 8K25	5322 116 53267
R 0330	MRS25 1% 287E	5322 116 53221
R 0331	MRS25 1% 100E	5322 116 53126
R 0332	MRS25 1% 2K49	5322 116 53574
R 0333	MRS25 1% 3K65	5322 116 53245
R 0334	MRS25 1% 3K65	5322 116 53245
R 0335	MRS25 1% 2K49	5322 116 53574
R 0336	MRS25 1% 3K65	5322 116 53245
R 0337	MRS25 1% 681E	4822 116 53123
R 0338	MRS25 1% 121K	4822 116 52958
R 0339	MRS25 1% 3K48	4822 116 53315
R 0340	MRS25 1% 10K	4822 116 53022
R 0341	MRS25 1% 10K	4822 116 53022
R 0342	MRS25 1% 100E	5322 116 53126
R 0343	MRS25 1% 14E7	4822 116 53037
R 0344	MRS25 1% 10K	4822 116 53022
R 0345	MRS25 1% 10K	4822 116 53022
R 0346	MRS25 1% 10K	4822 116 53022
R 0347	MRS25 1% 10K	4822 116 53022
R 0348	MRS25 1% 8K25	5322 116 53267
R 0349	MRS25 1% 8K25	5322 116 53267
R 0350	MRS25 1% 8K25	5322 116 53267
R 0351	MRS25 1% 8K25	5322 116 53267
R 0352	MRS25 1% 287E	5322 116 53221
R 0353	MRS25 1% 100E	5322 116 53126
R 0354	MRS25 1% 2K87	5322 116 53513
R 0355	MRS25 1% 287E	5322 116 53221
R 0356	MRS25 1% 100E	5322 116 53126
R 0357	MRS25 1% 2K87	5322 116 53513
R 0358	MRS25 1% 287E	5322 116 53221
R 0359	MRS25 1% 100E	5322 116 53126
R 0360	MRS25 1% 2K87	5322 116 53513
R 0361	MRS25 1% 287E	5322 116 53221
R 0362	MRS25 1% 100E	5322 116 53126
R 0363	MRS25 1% 2K87	5322 116 53513
R 0364	MRS25 1% 100E	5322 116 53126
R 0365	MRS25 1% 249E	5322 116 53573
R 0366	MRS25 1% 301K	5322 116 53328
R 0601	MRS25 1% 10K	4822 116 53022
R 0602	MRS25 1% 100E	5322 116 53126
R 0603	MRS25 1% 100E	5322 116 53126
R 0604	MRS25 1% 10K	4822 116 53022
R 0605	MRS25 1% 100K	4822 116 52973
R 0606	MRS25 1% 1M	4822 116 52843
R 0607	MRS25 1% 2K74	4822 116 53055
R 0608	MRS25 1% 4K64	5322 116 53212
R 0609	MRS25 1% 8K66	5322 116 53625
R 0610	MRS25 1% 10K	4822 116 53022
R 0612	MRS25 1% 10K	4822 116 53022
R 1201	VR25 5% 5M6	4822 110 72207
R 1202	MRS25 1% 590K	5322 116 53336
R 1203	MRS25 1% 90K9	5322 116 53582

POSNR	DESCRIPTION	ORDERING CODE
R 1204	MRS25 1% 10K	4822 116 53022
R 1205	MRS25 1% 100K	4822 116 52973
R 1206	MRS25 1% 100K	4822 116 52973
R 1207	MRS25 1% 100K	4822 116 52973
R 1208	MRS25 1% 178K	5322 116 53555
R 1209	MRS25 1% 36K5	5322 116 53557
R 1210	MRS25 1% 1M	4822 116 52843
R 1211	MRS25 1% 1M	4822 116 52843
R 1212	0.1% 8K76	5322 116 52117
R 1213	MRS25 1% 1K15	5322 116 80101
R 1214	VR25 5% 8M2	4822 110 72212
R 1215	MRS25 1% 30E1	5322 116 53638
R 1217	1/4W 0.1% 17K8	5322 116 52387
R 1218	MRS25 1% 10K	4822 116 53022
R 1219	MRS25 1% 5K11	5322 116 53494
R 1220	MRS25 1% 1M	4822 116 52843
R 1221	MRS25 1% 100E	5322 116 53126
R 1222	MRS25 1% 4K87	5322 116 53333
R 1223	MRS25 1% 20E5	5322 116 53635
R 1224	MRS25 1% 20E5	5322 116 53635
R 1300	MRS25 1% 100E	5322 116 53126
R 1301	245V 750E-1K5	5322 116 44006
R 1302	MRS25 1% 100K	4822 116 52973
R 1303	MRS25 1% 750E	5322 116 53265
R 1304	MRS25 1% 10K	4822 116 53022
R 1305	MRS25 1% 1K	4822 116 53108
R 1306	MRS25 1% 1K	4822 116 53108
R 1307	MRS25 1% 6E19	5322 116 80148
R 1308	265V 20% 100E	4822 116 40006
R 1309	MRS25 1% 100K	4822 116 52973
R 1310	MRS25 1% 100K	4822 116 52973
R 1311	MTP10 20% 100K	5322 101 10508
R 1312	VR25 5% 10M	4822 110 72214
R 1313	MRS25 1% 1M	4822 116 52843
R 1314	MRS25 1% 12K1	4822 116 52957
R 1315	MRS25 1% 40K2	5322 116 53613
R 1316	MTP10 20% 100K	5322 101 10508
R 1317	VR25 5% 10M	4822 110 72214
R 1318	MRS25 1% 383E	5322 116 53332
R 1319	MRS25 1% 59K	4822 116 80036
R 1320	MRS25 1% 46K4	5322 116 53314
R 1321	MRS25 1% 464K	5322 116 53247
R 1322	MRS25 1% 46K4	5322 116 53314
R 1323	MRS25 1% 10K	4822 116 53022
R 1324	MRS25 1% 90K9	5322 116 53582
R 1325	MRS25 1% 1M	4822 116 52843
R 1326	MRS25 1% 51K1	4822 116 53121
R 1327	MRS25 1% 1K	4822 116 53108
R 1328	MRS25 1% 1M	4822 116 52843
R 1329	MRS25 1% 100K	4822 116 52973
R 1330	MRS25 1% 1M	4822 116 52843
R 1331	1W 20% 50E	4822 116 30008
R 1332	MRS25 1% 40K2	5322 116 53613
R 1333	MRS25 1% 40K2	5322 116 53613
R 1336	MRS25 1% 100K	4822 116 52973
R 1401	VR25 5% 10M	4822 110 72214
R 1402	MRS25 1% 100K	4822 116 52973
R 1403	MRS25 1% 226E	5322 116 53242
R 1404	MRS25 1% 100K	4822 116 52973
R 1405	MRS25 1% 2K26	5322 116 53243
R 1407	MRS25 1% 1K	4822 116 53108
R 1409	MRS25 1% 3K01	5322 116 53255
R 1410	MRS25 1% 7K5	4822 116 53028
R 1411	MRS25 1% 15K4	5322 116 53234
R 1412	MRS25 1% 365E	5322 116 53575

POSNR	DESCRIPTION	ORDERING CODE
R 1413	MRS25 1% 487E	5322 116 53642
R 1414	MRS25 1% 10E	4822 116 52891
R 1416	MRS25 1% 348E	5322 116 53591
R 1417	MRS25 1% 140E	5322 116 53542
R 1418	MRS25 1% 1K1	5322 116 53473
R 1419	MRS25 1% 2K61	5322 116 53327
R 1420	MRS25 1% 402E	5322 116 53639
R 1421	MRS25 1% 402E	5322 116 53639
R 1422	MRS25 1% 10E	4822 116 52891
R 1424	MRS25 1% 127E	5322 116 53631
R 1425	MRS25 1% 10E	4822 116 52891
R 1426	MRS25 1% 909E	4822 116 53533
R 1427	MRS25 1% 100E	5322 116 53126
R 1428	MRS25 1% 10K	4822 116 53022
R 1429	MRS25 1% 10K	4822 116 53022
R 1430	MRS25 1% 10K	4822 116 53022
R 1431	MRS25 1% 10K	4822 116 53022
R 1432	MRS25 1% 100K	4822 116 52973
R 1433	MRS25 1% 10K	4822 116 53022
R 1434	MRS25 1% 100K	4822 116 52973
R 1501	265V 20% 100E	4822 116 40006
R 1502	MRS25 1% 162K	5322 116 53535
R 1503	MRS25 1% 51K1	4822 116 53121
R 1504	MRS25 1% 1M	4822 116 52843
R 1505	MRS25 1% 46K4	5322 116 53314
R 1506	MRS25 1% 100K	4822 116 52973
R 1508	MRS25 1% 1K	4822 116 53108
R 1509	MRS25 1% 511E	5322 116 53135
R 1510	MRS25 1% 649K	5322 116 55331
R 1511	MRS25 1% 100K	4822 116 52973
R 1512	MRS25 1% 1K	4822 116 53108
R 1513	MRS25 1% 100K	4822 116 52973
R 1514	MRS25 1% 10K	4822 116 53022
R 1515	MRS25 1% 1K	4822 116 53108
R 1516	MRS25 1% 100K	4822 116 52973
R 1518	MRS25 1% 1K	4822 116 53108
R 1519	MRS25 1% 10K	4822 116 53022
R 1520	MRS25 1% 100K	4822 116 52973
R 1521	1/4W 0.1% 1K02	5322 116 80221
R 1522	VR25 5% 1M2	4822 110 72189
R 1523	MRS25 1% 1M	4822 116 52843
R 1524	MRS25 1% 100K	4822 116 52973
R 1525	MRS25 1% 100K	4822 116 52973
R 1526	MRS25 1% 34K8	5322 116 53429
R 1527	MRS25 1% 26K1	5322 116 53261
R 1528	MRS25 1% 100K	4822 116 52973
R 1530	MRS25 1% 1K62	5322 116 53257
R 1531	MRS25 1% 162K	5322 116 53535
R 1532	VR37 5% 16M	5322 116 64021
R 1533	MRS25 1% 249K	5322 116 80295
R 1534	MRS25 1% 19K6	5322 116 53258
R 1535	MRS25 1% 10K	4822 116 53022
R 1536	MRS25 1% 3K01	5322 116 53255
R 1537	MRS25 1% 169K	5322 116 53345
R 1538	MRS25 1% 30K1	5322 116 53209
R 1539	MRS25 1% 3K83	4822 116 53079
R 1540	MRS25 1% 10K	4822 116 53022
R 1541	MRS25 1% 10K	4822 116 53022
R 1542	MRS25 1% 10K	4822 116 53022
R 1548	MRS25 1% 365K	5322 116 80338
R 1549	MRS25 1% 100K	4822 116 52973
R 1550	0.1% 174K	5322 116 51891
R 1551	0.1% 174K	5322 116 51891
R 1552	MRS25 1% 5K62	5322 116 53495
R 1553	MRS25 1% 1K	4822 116 53108

POSNR	DESCRIPTION	ORDERING CODE
R 1554	VR25 5% 5M6	4822 110 72207
R 1555	MRS25 1% 10K	4822 116 53022
R 1556	MRS25 1% 10K	4822 116 53022
R 1557	MRS25 1% 100K	4822 116 52973
R 1558	MRS25 1% 100K	4822 116 52973
R 1559	MRS25 1% 100K	4822 116 52973
R 1560	MRS25 1% 100K	4822 116 52973
R 1561	MRS25 1% 100K	4822 116 52973
R 1562	MRS25 1% 100E	5322 116 53126
R 1563	MRS25 1% 100K	4822 116 52973
R 1565	MRS25 1% 2K05	5322 116 53324
R 1566	MRS25 1% 383K	5322 116 53576
R 1601	MRS25 1% 90K9	5322 116 53582
R 1602	MRS25 1% 2K49	5322 116 53574
R 1603	MRS25 1% 17K8	5322 116 53235
R 1604	MRS25 1% 1K62	5322 116 53257
R 1605	MRS25 1% 51E1	5322 116 53213
R 1606	MRS25 1% 3K65	5322 116 53245
R 1607	MRS25 1% 1K96	5322 116 53237
R 1608	MRS25 1% 3K48	4822 116 53315
R 1609	MRS25 1% 348E	5322 116 53591
R 1611	MRS25 1% 1K27	5322 116 53321
R 1614	MRS25 1% 464E	5322 116 53232
R 1615	MRS25 1% 1K	4822 116 53108
R 1700	MRS25 1% 8K66	5322 116 53625
R 1701	MRS25 1% 10K	4822 116 53022
R 1702	MRS25 1% 1K	4822 116 53108
R 1703	MRS25 1% 8K25	5322 116 53267
R 1704	MRS25 1% 10K	4822 116 53022
R 1705	MRS25 1% 100K	4822 116 52973
R 1706	MRS25 1% 100K	4822 116 52973
R 1707	MRS25 1% 100K	4822 116 52973
R 1708	MRS25 1% 100E	5322 116 53126
R 1709	MRS25 1% 10K	4822 116 53022
R 1710	MRS25 1% 100E	5322 116 53126
R 1711	MRS25 1% 10K	4822 116 53022
R 1712	MRS25 1% 100E	5322 116 53126
R 1713	MRS25 1% 10K	4822 116 53022
R 1714	MRS25 1% 100E	5322 116 53126
R 1715	MRS25 1% 10K	4822 116 53022
R 1716	MRS25 1% 100E	5322 116 53126
R 1717	MRS25 1% 100E	5322 116 53126
R 1718	-105-103 10K	5322 111 90473
R 1719	-105-103 10K	5322 111 90473
R 1720	MRS25 1% 10K	4822 116 53022
R 1721	MRS25 1% 127K	5322 116 53601
R 1722	MRS25 1% 287E	5322 116 53221
R 1723	MRS25 1% 287E	5322 116 53221
R 1724	MRS25 1% 1M	4822 116 52843
R 1725	MRS25 1% 287E	5322 116 53221
R 1726	MRS25 1% 287E	5322 116 53221
R 1727	MRS25 1% 287E	5322 116 53221
R 1728	MRS25 1% 22E6	5322 116 53637
R 1729	MRS25 1% 287E	5322 116 53221
R 1730	MRS25 1% 3K32	5322 116 53211
R 1731	MRS25 1% 100E	5322 116 53126
R 1732	MRS25 1% 100E	5322 116 53126
R 1733	MRS25 1% 100E	5322 116 53126
R 1734	MRS25 1% 5K11	5322 116 53494
R 1735	MRS25 1% 5K11	5322 116 53494
R 1736	MRS25 1% 5K11	5322 116 53494
R 1737	MRS25 1% 100E	5322 116 53126
R 1738	MRS25 1% 100E	5322 116 53126
R 1739	MRS25 1% 100K	4822 116 52973
R 1740	MRS25 1% 100K	4822 116 52973

POSNR	DESCRIPTION		ORDERING CODE
R 1741	MRS25 1% 100K		4822 116 52973
R 1742	MRS25 1% 100K		4822 116 52973
R 1744	MRS25 1% 100K		4822 116 52973
R 1745	MRS25 1% 46K4		5322 116 53314
R 1746	MRS25 1% 10K		4822 116 53022
R 1747	MRS25 1% 100K		4822 116 52973
R 1748	MRS25 1% 46K4		5322 116 53314
R 1749	MRS25 1% 5K11		5322 116 53494
R 1750	MRS25 1% 4K64		5322 116 53212
R 1751	MRS25 1% 100K		4822 116 52973
R 1752	MRS25 1% 100E		5322 116 53126
R 1753	MRS25 1% 100K		4822 116 52973
R 1754	MRS25 1% 33K2		5322 116 53244
R 1755	MRS25 1% 10K		4822 116 53022
R 1756	MRS25 1% 7K5		4822 116 53028
R 1757	MRS25 1% 100K		4822 116 52973
R 1758	MRS25 1% 20K5		5322 116 53238
R 2101	MRS25 1% 196K		5322 116 53661
R 2102	MRS25 1% 3K48		4822 116 53315
R 2103	MRS25 1% 3K32		5322 116 53211
R 2104	MRS25 1% 590E		4822 116 53584
R 2105	CTP10 20% 220E		4822 100 10019
R 2201	MRS25 1% 10K		4822 116 53022
S 1701	1-P		5322 276 11577
S 2201	1-P		4822 276 11076
S 2202	1-P		4822 276 11076
S 2203	1-P		4822 276 11076
S 2204	1-P		4822 276 11076
S 2205	1-P		4822 276 11076
S 2206	1-P		4822 276 11076
S 2207	1-P		4822 276 11076
S 2208	1-P		4822 276 11076
S 2209	1-P		4822 276 11076
S 2210	1-P		4822 276 11076
S 2211	1-P		4822 276 11076
S 2212	1-P		4822 276 11076
S 2213	1-P		4822 276 11076
S 2214	1-P		4822 276 11076
S 2215	1-P		4822 276 11076
S 2216	1-P		4822 276 11076
S 2217	1-P		5322 276 11577
S 2218	1-P		5322 276 11577
V 0301	BC559B	PEL	4822 130 44358
V 0302	BC547B	PEL	4822 130 40959
V 0303	BC547B	PEL	4822 130 40959
V 0304	BSX20	PEL	4822 130 41705
V 0306	BSX20	PEL	4822 130 41705
V 0308	BC559B	PEL	4822 130 44358
V 0309	BC547B	PEL	4822 130 40959
V 0310	BC547B	PEL	4822 130 40959
V 0311	BC559B	PEL	4822 130 44358
V 0312	BC547B	PEL	4822 130 40959
V 0313	BC547B	PEL	4822 130 40959
V 0314	BSX20	PEL	4822 130 41705
V 0316	BSX20	PEL	4822 130 41705
V 0318	BC559B	PEL	4822 130 44358
V 0319	BC547B	PEL	4822 130 40959
V 0320	BC547B	PEL	4822 130 40959
V 0322	BYV27-150	PEL	4822 130 31628
V 0323	BYV27-150	PEL	4822 130 31628
V 0324	BYV27-150	PEL	4822 130 31628
V 0325	BYV27-150	PEL	4822 130 31628
V 0328	BC559B	PEL	4822 130 44358
V 0329	BC327	PEL	4822 130 40854
V 0330	BSX20	PEL	4822 130 41705

POSNR	DESCRIPTION		ORDERING CODE
V 0331	BSX20	PEL	4822 130 41705
V 0332	BSX20	PEL	4822 130 41705
V 0333	BSX20	PEL	4822 130 41705
V 0334	BC547B	PEL	4822 130 40959
V 0606	BAT85	PEL	4822 130 31983
V 1201	BF256A	PEL	5322 130 44418
V 1202	BF256A	PEL	5322 130 44418
V 1203	BF256A	PEL	5322 130 44418
V 1204	BF256A	PEL	5322 130 44418
V 1205	BF256A	PEL	5322 130 44418
V 1206	BF256A	PEL	5322 130 44418
V 1207	BSV80	PEL	5322 130 34044
V 1303	BC549C	PEL	4822 130 44246
V 1304	BC559B	PEL	4822 130 44358
V 1305	BC559B	PEL	4822 130 44358
V 1306	BF256B	PEL	5322 130 44744
V 1307	BF256B	PEL	5322 130 44744
V 1308	BC559B	PEL	4822 130 44358
V 1309	BC549C	PEL	4822 130 44246
V 1310	BC549C	PEL	4822 130 44246
V 1311	BC549C	PEL	4822 130 44246
V 1312	BC559B	PEL	4822 130 44358
V 1313	BC559B	PEL	4822 130 44358
V 1314	BC549C	PEL	4822 130 44246
V 1315	BF256A	PEL	5322 130 44418
V 1350	BZT03-C7V5	PEL	4822 130 31913
V 1351	BZT03-C7V5	PEL	4822 130 31913
V 1352	BZT03-C7V5	PEL	4822 130 31913
V 1353	BZT03-C7V5	PEL	4822 130 31913
V 1354	BYW56	PEL	5322 130 34973
V 1355	BYW56	PEL	5322 130 34973
V 1356	BAT85	PEL	4822 130 31983
V 1357	BAT85	PEL	4822 130 31983
V 1401	BF256B	PEL	5322 130 44744
V 1403	BF199	PEL	4822 130 44154
V 1404	BF199	PEL	4822 130 44154
V 1405	BF324	PEL	4822 130 41448
V 1406	BF324	PEL	4822 130 41448
V 1407	BF324	PEL	4822 130 41448
V 1408	BC547B	PEL	4822 130 40959
V 1410	BSX20	PEL	4822 130 41705
V 1411	BC549C	PEL	4822 130 44246
V 1412	BC559B	PEL	4822 130 44358
V 1450	BAT85	PEL	4822 130 31983
V 1451	BAT85	PEL	4822 130 31983
V 1452	BAT85	PEL	4822 130 31983
V 1453	BAT85	PEL	4822 130 31983
V 1500	BC549C	PEL	4822 130 44246
V 1502	BF256A	PEL	5322 130 44418
V 1503	BF256A	PEL	5322 130 44418
V 1504	BSV80	PEL	5322 130 34044
V 1505	BF256A	PEL	5322 130 44418
V 1506	BF256A	PEL	5322 130 44418
V 1507	BF256A	PEL	5322 130 44418
V 1508	BF256A	PEL	5322 130 44418
V 1509	BF256A	PEL	5322 130 44418
V 1510	BF256A	PEL	5322 130 44418
V 1511	BSV80	PEL	5322 130 34044
V 1512	BC337	PEL	4822 130 40855
V 1513	BC549C	PEL	4822 130 44246
V 1514	BC549C	PEL	4822 130 44246
V 1515	BC549C	PEL	4822 130 44246
V 1516	BC549C	PEL	4822 130 44246
V 1517	BF256A	PEL	5322 130 44418
V 1518	BF256A	PEL	5322 130 44418

POSNR	DESCRIPTION		ORDERING CODE
V 1519	BF256A	PEL	5322 130 44418
V 1520	BF256A	PEL	5322 130 44418
V 1521	BF256A	PEL	5322 130 44418
V 1522	BC549C	PEL	4822 130 44246
V 1523	BF256A	PEL	5322 130 44418
V 1524	BF256A	PEL	5322 130 44418
V 1525	BC549C	PEL	4822 130 44246
V 1526	BF256A	PEL	5322 130 44418
V 1550	BYW56	PEL	5322 130 34973
V 1551	BYW56	PEL	5322 130 34973
V 1552	BZT03-C7V5	PEL	4822 130 31913
V 1553	BAW62	PEL	4822 130 30613
V 1554	BAW62	PEL	4822 130 30613
V 1555	BZV12	PEL	5322 130 34269
V 1558	BAT85	PEL	4822 130 31983
V 1560	BAW62	PEL	4822 130 30613
V 1601	BC549C	PEL	4822 130 44246
V 1602	BD139	PEL	4822 130 40823
V 1650	BYW56	PEL	5322 130 34973
V 1651	BYW56	PEL	5322 130 34973
V 1652	BYW56	PEL	5322 130 34973
V 1653	BYW56	PEL	5322 130 34973
V 1654	BYW56	PEL	5322 130 34973
V 1655	BYW56	PEL	5322 130 34973
V 1656	BYW56	PEL	5322 130 34973
V 1657	BYW56	PEL	5322 130 34973
V 1658	BZX79-B3V3	PEL	5322 130 31504
V 1659	BZX79-B3V3	PEL	5322 130 31504
V 1660	BZX79-B3V3	PEL	5322 130 31504
V 1661	BZX79-B3V3	PEL	5322 130 31504
V 1662	BAW62	PEL	4822 130 30613
V 1663	BAT85	PEL	4822 130 31983
V 1664	BAT85	PEL	4822 130 31983
V 1665	BAX18	PEL	4822 130 34121
V 1666	BZX79-B3V3	PEL	5322 130 31504
V 1667	BAW62	PEL	4822 130 30613
V 1701	BC549C	PEL	4822 130 44246
V 1702	BC559B	PEL	4822 130 44358
V 1703	BC549C	PEL	4822 130 44246
V 1704	BC327	PEL	4822 130 40854
V 1705	BC337	PEL	4822 130 40855
V 1706	BC327	PEL	4822 130 40854
V 1707	BC337	PEL	4822 130 40855
V 1708	BC327	PEL	4822 130 40854
V 1709	BC549C	PEL	4822 130 44246
V 1710	BC549C	PEL	4822 130 44246
V 1711	BC549C	PEL	4822 130 44246
V 1712	BC549C	PEL	4822 130 44246
V 1713	BC549C	PEL	4822 130 44246
V 1714	BC549C	PEL	4822 130 44246
V 1715	BC549C	PEL	4822 130 44246
V 1717	BC549C	PEL	4822 130 44246
V 1718	BC549C	PEL	4822 130 44246
V 1719	BC559B	PEL	4822 130 44358
V 1720	BC327	PEL	4822 130 40854
V 1721	BC559B	PEL	4822 130 44358
V 1722	BC549C	PEL	4822 130 44246
V 1723	BC549C	PEL	4822 130 44246
V 1724	BC549C	PEL	4822 130 44246
V 1750	BRY39	PEL	5322 130 40482
V 1751	BAT85	PEL	4822 130 31983
V 1752	BAT85	PEL	4822 130 31983
V 1753	BAT85	PEL	4822 130 31983
V 1756	BAT85	PEL	4822 130 31983
V 1757	BAW62	PEL	4822 130 30613

POSNR	DESCRIPTION		ORDERING CODE
V 1757	BAT85	PEL	4822 130 31983
V 1758	BAT85	PEL	4822 130 31983
V 1759	BAT85	PEL	4822 130 31983
V 1760	BAW62	PEL	4822 130 30613
V 1761	BAW62	PEL	4822 130 30613
V 1762	BAW62	PEL	4822 130 30613
V 1763	BAW62	PEL	4822 130 30613
V 1764	BAT85	PEL	4822 130 31983
V 1765	BZV46-C1V5	PEL	5322 130 34865
V 1766	BZV46-C2V0	PEL	4822 130 31248
V 1767	BAW62	PEL	4822 130 30613
V 1768	BZV46-C1V5	PEL	5322 130 34865
V 1769	BAT85	PEL	4822 130 31983
V 1770	BAT85	PEL	4822 130 31983
V 1771	BAT85	PEL	4822 130 31983
V 2101	BZV46-C1V5	PEL	5322 130 34865
V 2102	BC547B	PEL	4822 130 40959
X 0301	10-P DBL STRGHT		5322 265 40485
X 0302	10-P DBL STRGHT		5322 265 40485
X 0601	24P SQR IEEE		5322 267 60162
X 0602	10-P DBL STRGHT		5322 265 40485
X 1001	8-P PW HAAKS		5322 267 54107
X 1601	10-P DBL STRGHT		5322 265 40485
X 1701	7-P SNG STRGHT		5322 265 40668
X 2101	G STRGHT		5322 267 50748

8.5 PARTS LIST RS232 INTERFACE N11000

* * * * S E R V I C E - P A R T S L I S T F O R 9447 025 25611

SERVICECODE	FP	FR	DESCRIPTION	ART.SPECIFIC.	POS.NR	QQ
			R C M D S PER MAG UN HIG CUS GEN			
5322 693 21929	12	000	UNIT,ELECTRICAL V24 INTERFACE A9190			1
			0 0 0 0 0 000 0 13 0 0			
5322 209 51448	12	000	I.C. ROM ROM 9190		A2 .	1
			0 0 0 0 0 000 0 13 0 0			
5322 209 72599	12	000	INTEGR.CIRCUIT DUART		D11002	1
			0 0 0 0 0 000 0 13 0 0			
5322 218 61098	12	000	BOARD,PRINTED GALVANIC PRINT		A300 .	1
			0 0 0 0 0 000 0 13 0 0			
5322 321 21585	12	000	CABLE,CONNECT. CABLE ASSY			1
			0 0 0 0 0 000 0 13 0 0			
4822 122 31414	13	000	CAP.CERAMIC CAP 100V -20+50 10NF		C11001	1
			0 0 0 000 0 13 0 1			
5322 124 21959	12	000	CAP.ELECTROLYT. ALCAP 25V 20 1UF		C11002	1
			0 0 0 000 0 13 0 1			
4822 124 20943	13	000	CAP.SOLID ALU. ALCAP 6,3V 20 22UF		C11005	1
			0 0 0 000 0 13 0 1			
4822 122 31414	13	000	CAP.CERAMIC CAP 100V -20+50 10NF		C11007	1
			0 0 0 000 0 13 0 1			
5322 124 10665	13	000	CAP.HI-TENSION ALCAP 10V 20 15UF		C11008	1
			0 0 0 000 0 13 0 1			
5322 124 10665	13	000	CAP.HI-TENSION ALCAP 10V 20 15UF		C11009	1
			0 0 0 000 0 13 0 1			
5322 124 10665	13	000	CAP.HI-TENSION ALCAP 10V 20 15UF		C11010	1
			0 0 0 000 0 13 0 1			
5322 124 10665	13	000	CAP.HI-TENSION ALCAP 10V 20 15UF		C11011	1
			0 0 0 000 0 13 0 1			
5322 124 10665	13	000	CAP.HI-TENSION ALCAP 10V 20 15UF		C11012	1
			0 0 0 000 0 13 0 1			
5322 124 10665	13	000	CAP.HI-TENSION ALCAP 10V 20 15UF		C11013	1
			0 0 0 000 0 13 0 1			
4822 122 31414	13	000	CAP.CERAMIC CAP 100V -20+50 10NF		C11014	1
			0 0 0 000 0 13 0 1			
4822 122 31414	13	000	CAP.CERAMIC CAP 100V -20+50 10NF		C11015	1
			0 0 0 000 0 13 0 1			
4822 122 31414	13	000	CAP.CERAMIC CAP 100V -20+50 10NF		C11016	1
			0 0 0 000 0 13 0 1			

| | | |

4822 130 44246	13	000	TRANSISTOR		BC549C						V11024	1
			0 0 0 0 000	0	13		0		1			
4822 130 40854	13	000	TRANSISTOR		BC327						V11025	1
			0 0 0 0 0 000	0	13		0		1			
5322 130 33756	13	000	DIODE		BAX12						V11026	1
			0 0 0 000	0	13		0		0			
5322 265 51188	12	000	CONNECTOR		CONNECTOR 10P						X11001	1
			0 0 0 0 0 000	0	13		0		0			
4822 266 51009	12	000	CONNECTOR		CONNECTOR 25P						X11002	1
			0 0 0 0 0 000	0	13		0		0			
5322 209 51444	12	000	I.C. ROM		ROM						D1710.	1
			0 0 0 0 0 000	0	13		0		0			

8.6 PARTS LIST ANALOG OUTPUT N21000

* * * * S E R V I C E - P A R T S L I S T F O R 9447 025 25711

SERVICECODE	FP	FR	DESCRIPTION	ART.SPECIFIC.							POS.NR	
			R C M D S PER	MAG	UN	HIG	CUS		GEN			00
5322 693 21931	12	000	UNIT,ELECTRICAL ANALOG OUTPUT									
			0 0 0 0 0 000	0	13		0		0			
5322 267 34057	12	000	PLUG,COAX.FEMAL SOCKET BLACK									1
			0 0 0 0 0 000	0	13		0		0			
5322 267 30527	12	000	PLATE,CONTACT SOCKET RED									1
			0 0 0 0 0 000	0	13		0		0			
4822 122 31414	13	000	CAP.CERAMIC	CAP 100V-20+50 10NF							C21001	1
			0 0 0 000	0	13		0		1			
5322 124 21959	12	000	CAP.ELECTROLYT.	ALCAP 25V 20 1NF							C21002	1
			0 0 0 000	0	13		0		1			
5322 122 32072	13	000	CAP.CERAMIC	CAP 100V 2 33PF							C21003	1
			0 0 0 000	0	13		0		1			
5322 122 32072	13	000	CAP.CERAMIC	CAP 100V 2 33PF							C21004	1
			0 0 0 000	0	13		0		1			
4822 124 20943	13	000	CAP.SOLID ALU.	ALCAP 6,3V 20 22UF							C21005	1
			0 0 0 000	0	13		0		1			
4822 124 20943	13	000	CAP.SOLID ALU.	ALCAP 6,3V 20 22UF							C21006	1
			0 0 0 000	0	13		0		1			
4822 122 31414	13	000	CAP.CERAMIC	CAP 100V-20+50 10NF							C21007	1
			0 0 0 000	0	13		0		1			
4822 122 30103	13	000	CAP.CERAMIC	CAP 40V-20+80 22NF							C21008	1
			0 0 0 000	0	13		0		1			
5322 124 21959	12	000	CAP.ELECTROLYT.	ALCAP 25V 20 1UF							C21009	1
			0 0 0 000	0	13		0		1			
4822 124 21317	13	000	CAP.SOLID ALU.	ALCAP 40V 20 680NF							C21010	1
			0 0 0 000	0	13		0		1			
4822 122 30034	13	000	CAP.CERAMIC	CAP 100V 10 470PF							C21011	1
			0 0 0 000	0	13		0		1			
4822 122 32121	13	000	CAP.CERAMIC	CAP 100V 2 390PF							C21012	1
			0 0 0 000	0	13		0		1			
4822 122 30103	13	000	CAP.CERAMIC	CAP -20+80 22NF							C21013	1
			0 0 0 000	0	13		0		1			
4822 122 31429	13	000	CAP.CERAMIC	CAP -20+50 6.8NF							C21014	1
			0 0 0 000	0	13		0		1			
4822 122 30103	13	000	CAP.CERAMIC	CAP -20+80 22UF							C21015	1
			0 0 0 000	0	13		0		1			
5322 124 21763	12	000	CAP.SOLID ALU.	ALCAP 16V 20 6.8UF							C21016	1
			0 0 0 000	0	13		0		1			
4822 122 31414	13	000	CAP.CERAMIC	CAP 100V -20+50 10NF							C21017	1
			0 0 0 000	0	13		0		1			
5322 124 21764	12	000	CAP.SOLID ALU.	ALCAP 25V 20 2.2UF							C21018	1
			0 0 0 000	0	13		0		1			
4822 122 31414	13	000	CAP.CERAMIC	CAP 100V -20+50 10NF							C21019	1
			0 0 0 000	0	13		0		1			
4822 122 31414	13	000	CAP.CERAMIC	CAP 100V -20+50 10NF							C21020	1
			0 0 0 000	0	13		0		1			
4822 122 31414	13	000	CAP.CERAMIC	CAP 100V -20+50 10NF							C21021	1
			0 0 0 000	0	13		0		1			
4822 122 32121	13	000	CAP.CERAMIC	CAP 100V 2 390PF							C21022	1
			0 0 0 000	0	13		0		1			
5322 209 11131	12	000	INTEGR.CIRCUIT	UP MAF8441PT008							D21001	1
			0 0 0 0 0 000	0	13		0		1			
4822 209 10306	12	000	INTEGR.CIRCUIT	HEF4049BP							D21002	1
			0 0 0 000	0	13		0		1			

5322 209 10357	12	000	INTEGR.CIRCUIT	HEF4066BP							D21003	1
	0 0 0 000	0	13		0	1						
4822 242 70392	12	000	CRYSTAL	X-TAL 6000.000KHZ							G21001	1
	0 0 0 000	0	13		0	1						
4822 209 70672	12	000	INTEGR.CIRCUIT	IM358N							N21001	1
	0 0 0 0 0 000	0	13		0	0						
5322 209 84444	12	000	INTEGR.CIRCUIT	OQ0051							D21004	1
	0 0 0 0 0 000	0	13		0	0						
4822 116 53022	13	000	RES.METAL FILM	MRS25	1%	10K					R21001	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53126	13	000	RES.METAL FILM	MRS25	1%	100R					R21002	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53126	13	000	RES.METAL FILM	MRS25	1%	100R					R21003	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 53022	13	000	RES.METAL FILM	MRS25	1%	10K					R21004	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 52973	13	000	RES.METAL FILM	MRS25	1%	100K					R21005	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 52843	13	000	RES.METAL FILM	MRS25	1%	1M					R21006	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 53022	13	000	RES.METAL FILM	MRS25	1%	10K					R21007	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 53022	13	000	RES.METAL FILM	MRS25	1%	10K					R21008	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 53022	13	000	RES.METAL FILM	MRS25	1%	10K					R21009	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 53022	13	000	RES.METAL FILM	MRS25	1%	10K					R21010	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 53022	13	000	RES.METAL FILM	MRS25	1%	10K					R21011	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 52958	13	000	RES.METAL FILM	MRS25	1%	121K					R21012	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53535	13	000	RES.METAL FILM	MRS25	1%	162K					R21013	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53535	13	000	RES.METAL FILM	MRS25	1%	162K					R21014	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 52161	13	000	RES.METAL FILM	MRS25	1%	787K					R21015	1
	0 0 0 0 0 000	0	13		0	1						
4822 116 53423	13	000	RES.METAL FILM	MRS25	1%	470K					R21016	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53126	13	000	RES.METAL FILM	MRS25	1%	100K					R21017	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53126	13	000	RES.METAL FILM	MRS25	1%	100K					R21018	1
	0 0 0 0 0 000	0	13		0	1						
4822 110 72214	13	000	RES.HI-TENSION	VR25	5%	10M					R21019	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53234	13	000	RES.METAL FILM	MRS25	1%	15K4					R21020	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53126	13	000	RES.METAL FILM	MRS25	1%	100R					R21021	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53126	13	000	RES.METAL FILM	MRS25	1%	100R					R21022	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 52161	13	000	RES.METAL FILM	MRS25	1%	787K					R21023	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53234	13	000	RES.METAL FILM	MRS25	1%	15K4					R21024	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53543	13	000	RES.METAL FILM	MRS25	1%	15R					R21025	1
	0 0 0 0 0 000	0	13		0	1						
5322 116 53333	13	000	RES.METAL FILM	MRS25	1%	4K87					R21026	1
	0 0 0 0 0 000	0	13		0	1						
5322 101 14069	13	000	POTM.TRIMMER	POTM	20%	22K					R21027	1
	0 0 0 0 0 000	0	13		0	1						
5322 100 10112	12	000	POTM.TRIMMER	POTM	20%	1K					R21028	1
	0 0 0 0 0 000	0	13		0	1						
5322 277 21196	12	000	SWITCH,SLIDE	SWITCH 10P							S21001	1
	0 0 0 0 0 000	0	13		0	0						
4822 130 30613	13	000	DIODE	BAW62							V21003	1
	0 0 0 000	0	13		0	1						
4822 130 30613	13	000	DIODE	BAW62							V21004	1
	0 0 0 000	0	13		0	1						
5322 130 44248	12	000	TRANSISTOR,FET	BFQ12							V21005	1
	0 0 0 0 0 000	0	13		0	1						
4822 130 34173	13	000	DIODE,REFERENCE	BZX79-C5V6							V21006	1
	0 0 0 000	0	13		0	1						
4822 130 34173	13	000	DIODE,REFERENCE	BZX79-C5V6							V21007	1
	0 0 0 000	0	13		0	1						
5322 265 51188	12	000	CONNECTOR	MALE HEADER 10P							X21001	1
	0 0 0 0 0 000	0	13		0	0						
5322 321 21585	12	000	CABLE,CONNECT.	CABLE ASSY								1
	0 0 0 0 0 000	0	13		0	0						

8.7 PARTS LIST BATTERY P.C. BOARD

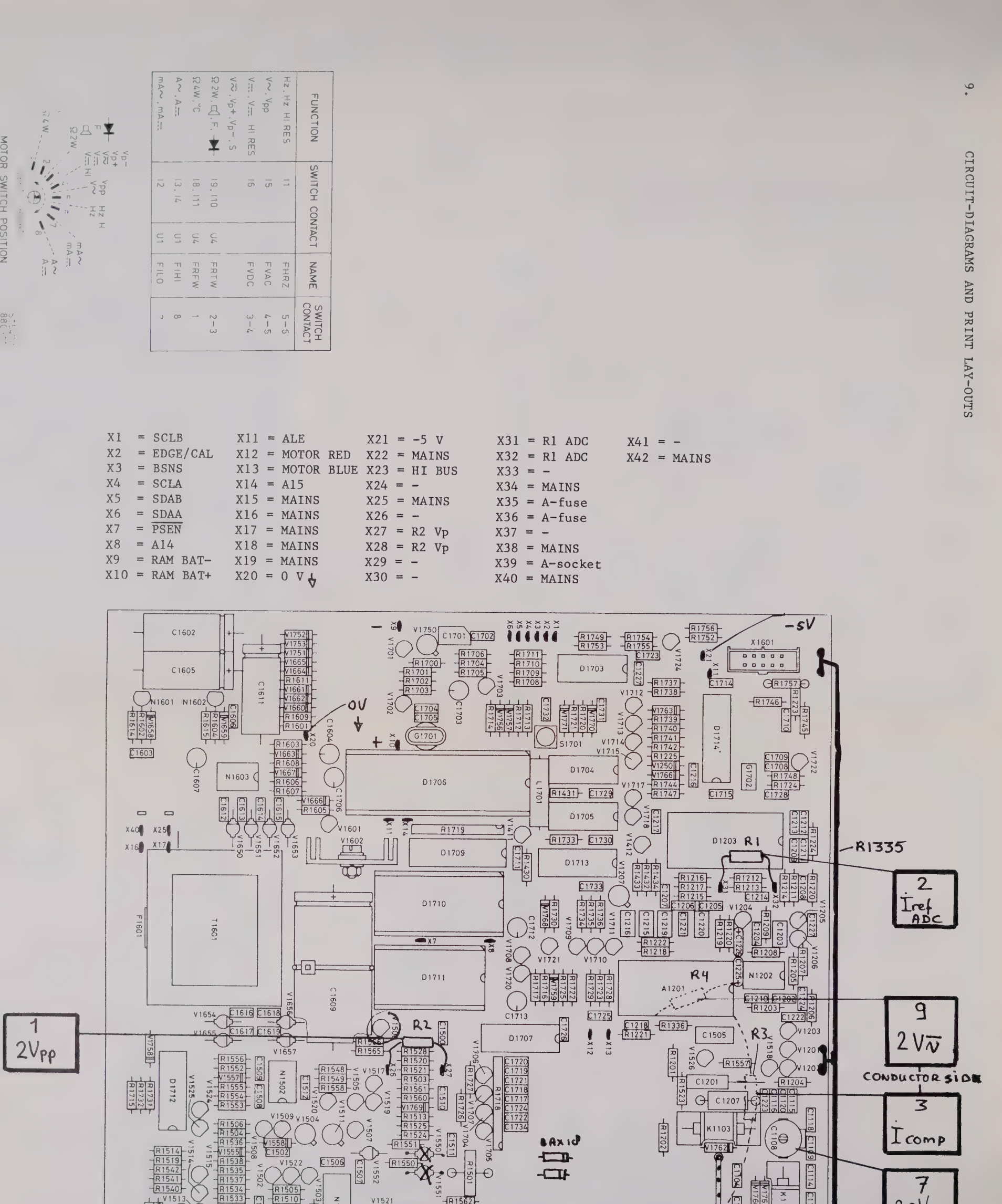
SERVICECODE	FP	FR	DESCRIPTION	ART.SPECIFIC.					POS.NR	
			R C M D S PER	MAG	UN	HIG	CUS	GEN		00
4822 253 30021	13	000	FUSE		T	5X20	1A		F 0002	1
			0 0 0 0 0 000	0	13		0	1		
5322 277 10974	12	000	SWITCH,TUMBLER						S 0401	1
			0 0 0 0 0 000	0	13		0	0		
4822 253 30021	13	000	FUSE		SMELTPATR					1
			0 0 0 0 0 000	0	13		0	1		
4822 122 31414	13	000	CAP.CERAMIC			-20+50%	10NF		C 0403	1
			0 0 0 000	0	13		0	1		
4822 122 31414	13	000	CAP.CERAMIC			-20+50%	10NF		C 0404	1
			0 0 0 000	0	13		0	1		
4822 122 31414	13	000	CAP.CERAMIC			-20+50%	10NF		C 0405	1
			0 0 0 000	0	13		0	1		
4822 122 31414	13	000	CAP.CERAMIC			-20+50%	10NF		C 0406	1
			0 0 0 000	0	13		0	1		
5322 124 21504	12	000	CAP.ELECTROLYT.			-20+20%	4700UF		C 0407	1
			0 0 0 0 0 000	0	13		0	1		
4822 124 20722	13	000	CAP.ELECTROLYT.			-10+50%	1UF		C 0408	1
			0 0 0 000	0	13		0	1		
4822 124 20722	13	000	CAP.ELECTROLYT.			-10+50%	1UF		C 0409	1
			0 0 0 000	0	13		0	1		
5322 121 42114	12	000	CAP.			63V 10%	1UF		C 0410	1
			0 0 0 0 0 000	0	13		0	1		
4822 122 31414	13	000	CAP.CERAMIC			-20+50%	10NF		C 0411	1
			0 0 0 000	0	13		0	1		
4822 124 20691	13	000	CAP.ELECTROLYT.			-10+50%	150UF		C 0413	1
			0 0 0 000	0	13		0	1		
4822 122 30103	13	000	CAP.CERAMIC			-20+80%	22NF		C 0414	1
			0 0 0 000	0	13		0	1		
5322 121 42114	12	000	CAP.			63V 10%	1UF		C 0415	1
			0 0 0 0 0 000	0	13		0	1		
4822 122 31316	13	000	CAP.CERAMIC			2%	100PF		C 0416	1
			0 0 0 000	0	13		0	1		
4822 121 41855	13	000	CAP.			63V 10%	220NF		C 0417	1
			0 0 0 0 0 000	0	13		0	1		
4822 253 30018	13	000	FUSE		T	5X20	630MA		F 0402	1
			0 0 0 0 0 000	0	13		0	1		
4822 209 70672	12	000	INTEGR.CIRCUIT	LM358N			N.S		N 0401	1
			0 0 0 0 0 000	0	13		0	0		
4822 209 70672	12	000	INTEGR.CIRCUIT	LM358N			N.S		N 0402	1
			0 0 0 0 0 000	0	13		0	0		
5322 116 53314	13	000	RES.METAL FILM	MRS25		1%	46K4		R 0401	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53514	13	000	RES.METAL FILM	MRS25		1%	316E		R 0402	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 52843	13	000	RES.METAL FILM	MRS25		1%	1M		R 0403	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 52998	13	000	RES.METAL FILM	MRS25		1%	4E87		R 0404	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 52998	13	000	RES.METAL FILM	MRS25		1%	4E87		R 0405	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53557	13	000	RES.METAL FILM	MRS25		1%	36K5		R 0406	1
			0 0 0 0 0 000	0	13		0	1		

SERVICECODE	FP	FR	DESCRIPTION	ART.SPECIFIC.					POS.NR	
			R C M D S PER	MAG	UN	HIG	CUS	GEN		00
5322 116 53243	13	000	RES.METAL FILM	MRS25		1%	2K26		R 0407	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53126	13	000	RES.METAL FILM	MRS25		1%	100E		R 0408	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 52973	13	000	RES.METAL FILM	MRS25		1%	100K		R 0409	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53579	13	000	RES.METAL FILM	MRS25		1%	6K49		R 0410	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 53108	13	000	RES.METAL FILM	MRS25		1%	1K		R 0411	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53579	13	000	RES.METAL FILM	MRS25		1%	6K49		R 0412	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53333	13	000	RES.METAL FILM	MRS25		1%	4K87		R 0413	1
			0 0 0 0 0 000	0	13		0	1		
5322 101 14008	13	000	POTM.TRIMMER	MTP10		20%	2K2		R 0414	1
			0 0 0 000	0	13		0	1		
4822 116 53022	13	000	RES.METAL FILM	MRS25		1%	10K		R 0415	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 53022	13	000	RES.METAL FILM	MRS25		1%	10K		R 0416	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53579	13	000	RES.METAL FILM	MRS25		1%	6K49		R 0417	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 52973	13	000	RES.METAL FILM	MRS25		1%	100K		R 0418	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53326	13	000	RES.METAL FILM	MRS25		1%	22K6		R 0419	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 53108	13	000	RES.METAL FILM	MRS25		1%	1K		R 0420	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53578	13	000	RES.METAL FILM	MRS25		1%	4K42		R 0421	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 52973	13	000	RES.METAL FILM	MRS25		1%	100K		R 0422	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53326	13	000	RES.METAL FILM	MRS25		1%	22K6		R 0423	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 52973	13	000	RES.METAL FILM	MRS25		1%	100K		R 0424	1
			0 0 0 0 0 000	0	13		0	1		
4822 116 53108	13	000	RES.METAL FILM	MRS25		1%	1K		R 0425	1
			0 0 0 0 0 000	0	13		0	1		
5322 116 53722	13	000	RES.METAL FILM	MRS25		1%	2E15		R 0426	1
			0 0 0 0 0 000	0	13		0	1		
5322 130 34973	13	000	DIODE	BYW56			PEL		V 0401	1
			0 0 0 000	0	13		0	1		
5322 130 34973	13	000	DIODE	BYW56			PEL		V 0402	1
			0 0 0 000	0	13		0	1		
5322 130 34973	13	000	DIODE	BYW56			PEL		V 0403	1
			0 0 0 000	0	13		0	1		
5322 130 34973	13	000	DIODE	BYW56			PEL		V 0404	1
			0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0405	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 34197	13	000	DIODE	BZX79-C12			PEL		V 0406	1
			0 0 0 000	0	13		0	1		

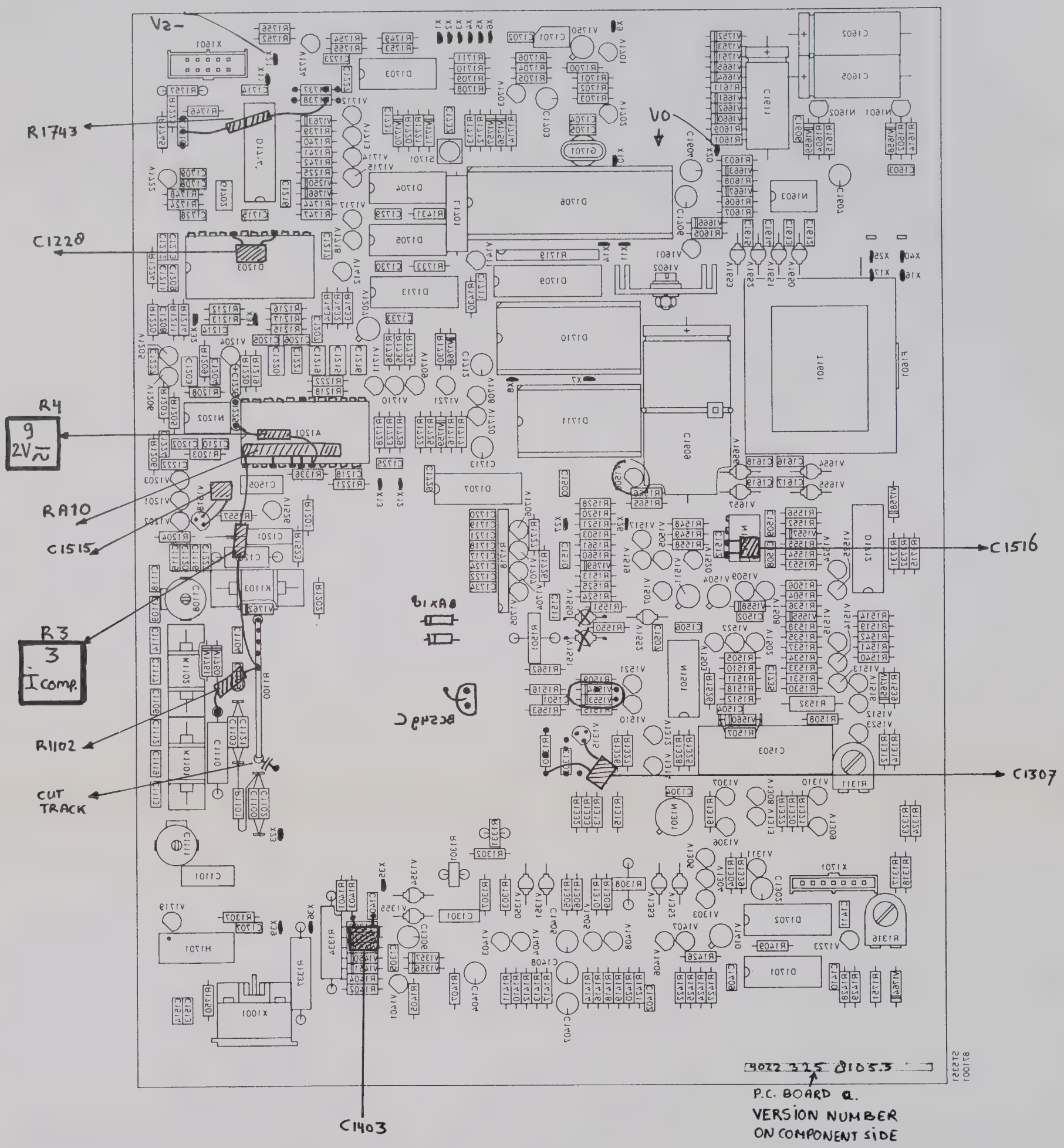
SERVICECODE	FP	FR	DESCRIPTION	ART.SPECIFIC.					POS.NR	
			R C M D S PER	MAG	UN	HIG	CUS	GEN		00
4822 130 34121	13	000	DIODE	BAX18			PEL		V 0407	1
			0 0 0 000	0	13		0	1		
4822 130 34121	13	000	DIODE	BAX18			PEL		V 0408	1
			0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0409	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0410	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0411	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0412	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0413	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0414	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0415	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0416	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0417	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0418	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 44568	13	000	TRANSISTOR	BC557B			PEL		V 0419	1
			0 0 0 000	0	13		0	1		
5322 130 44647	13	000	TRANSISTOR	BC368			PEL		V 0420	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 44568	13	000	TRANSISTOR	BC557B			PEL		V 0421	1
			0 0 0 000	0	13		0	1		
4822 130 40823	13	000	TRANSISTOR	BD139			PEL		V 0422	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 40959	13	000	TRANSISTOR	BC547B			PEL		V 0423	1
			0 0 0 000	0	13		0	1		
4822 130 40959	13	000	TRANSISTOR	BC547B			PEL		V 0424	1
			0 0 0 000	0	13		0	1		
4822 130 40959	13	000	TRANSISTOR	BC547B			PEL		V 0425	1
			0 0 0 000	0	13		0	1		
4822 130 40823	13	000	TRANSISTOR	BD139			PEL		V 0426	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 44568	13	000	TRANSISTOR	BC557B			PEL		V 0427	1
			0 0 0 000	0	13		0	1		
5322 130 34973	13	000	DIODE	BYW56			PEL		V 0428	1
			0 0 0 000	0	13		0	1		
5322 130 34973	13	000	DIODE	BYW56			PEL		V 0429	1
			0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0430	1
			0 0 0 0 0 000	0	13		0	1		
4822 130 30613	13	000	DIODE	BAW62			PEL		V 0431	1
			0 0 0 0 0 000	0	13		0	1		
5322 265 40642	12	000	CONNECTOR	P RECHT		QF50			X 0401	1
			0 0 0 0 0 000	0	13		0	0		

FUNCTION	SWITCH CONTACT		NAME	SWITCH CONTACT
Hz, Hz HI RES	11		FHRZ	5-6
V~, Vpp	15		FVAC	4-5
V⎓, V⎓ HI RES	16		FVDC	3-4
V≂, Vp+, Vp-, S				
Ω2W, ⏍, F, ▶|◀	19, 110	U4	FRTW	2-3
Ω4W, °C	18, 111	U4	FRFW	1
A~, A⎓	13, 14	U1	FIHI	8
mA~, mA⎓	12	U1	FILO	7

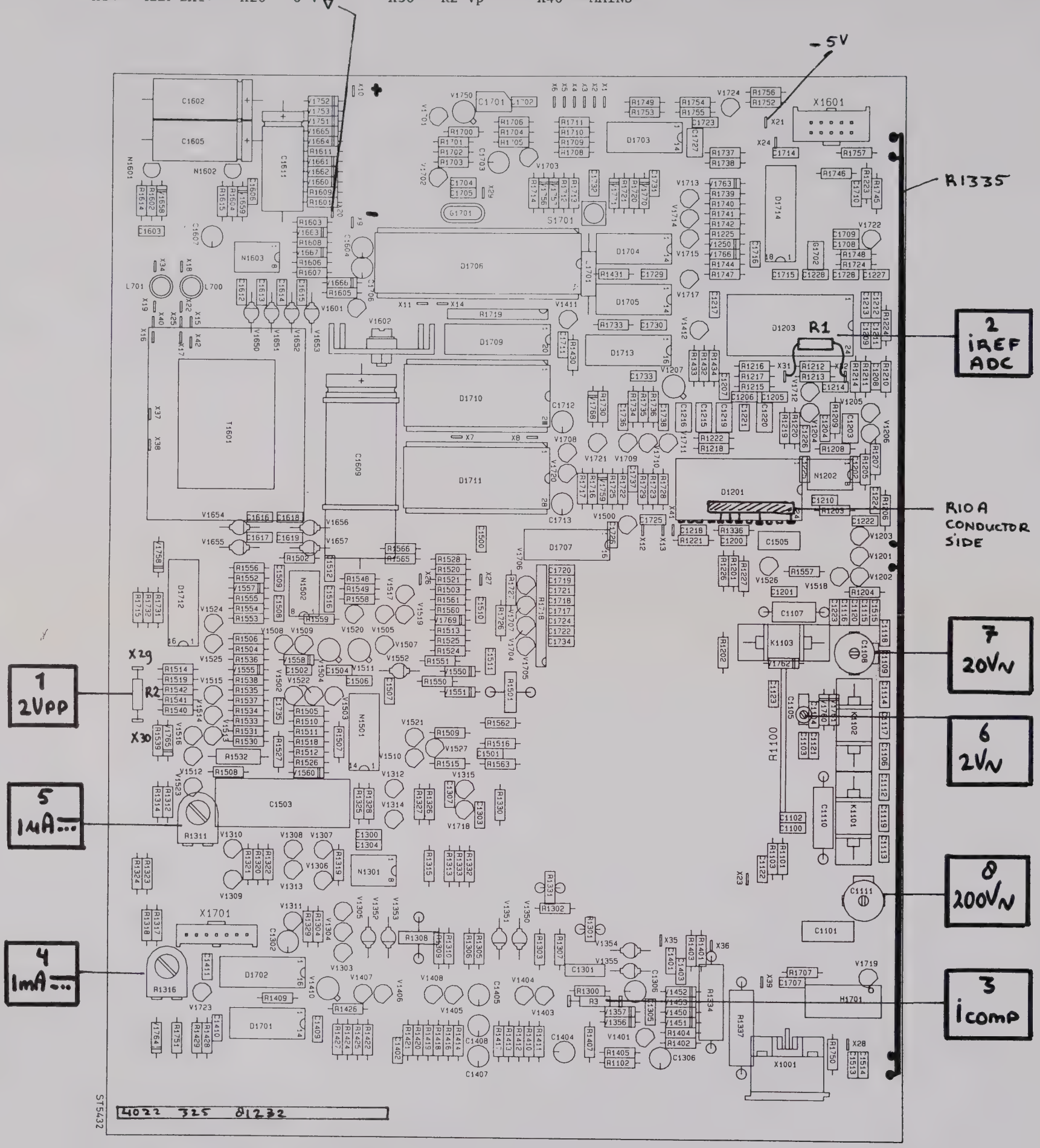
X1 = SCLB
X2 = EDGE/CAL
X3 = BSNS
X4 = SCLA
X5 = SDAB
X6 = SDAA
X7 = PSEN
X8 = A14
X9 = RAM BAT-
X10 = RAM BAT+
X11 = ALE
X12 = MOTOR RED
X13 = MOTOR BLUE
X14 = A15
X15 = MAINS
X16 = MAINS
X17 = MAINS
X18 = MAINS
X19 = MAINS
X20 = 0 V
X21 = -5 V
X22 = MAINS
X23 = HI BUS
X24 = -
X25 = MAINS
X26 = -
X27 = R2 Vp
X28 = R2 Vp
X29 = -
X30 = -
X31 = R1 ADC
X32 = R1 ADC
X33 = -
X34 = MAINS
X35 = A-fuse
X36 = A-fuse
X37 = -
X38 = MAINS
X39 = A-socket
X40 = MAINS
X41 = -
X42 = MAINS



P.C. BOARD A.
COMPONENT SIDE


R1743
C1220
R4
9
12V
RA10
C1515
R3
3
Icomp.
R1102
CUT TRACK
C1403
C1516
C1307
P.C. BOARD a.
VERSION NUMBER
ON COMPONENT SIDE
= ADJUSTMENT + NUMBER
= ADDITIONAL COMPONENTS
P.C. BOARD A.
CONDUCTOR SIDE

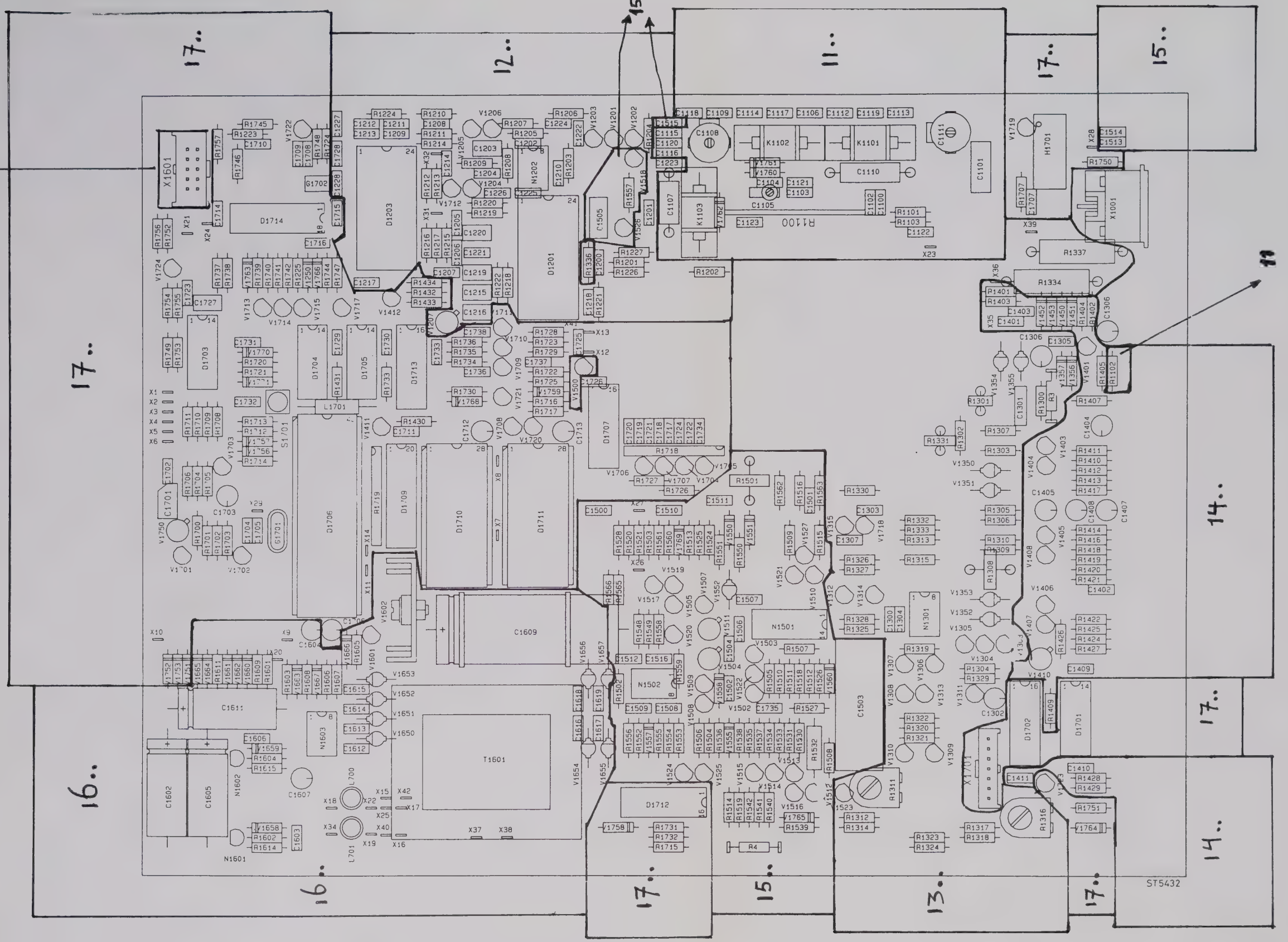
X1 = SCLB	X11 = ALE	X21 = -5 V	X31 = R1 ADC	X41 = -
X2 = EDGE/CAL	X12 = MOTOR RED	X22 = MAINS	X32 = R1 ADC	X42 = MAINS
X3 = BSNS	X13 = MOTOR BLUE	X23 = MAINS	X33 = -	X43 = R3 I comp.
X4 = SCLA	X14 = A15	X24 = -	X34 = MAINS	X44 = R3 I comp.
X5 = SCLB	X15 = MAINS	X25 = MAINS	X35 = A-fuse	
X6 = SDAA	X16 = MAINS	X26 = -	X36 = A-fuse	
X7 = $\overline{\text{PSEN}}$	X17 = MAINS	X27 = -	X37 = -	
X8 = A14	X18 = MAINS	X28 = -	X38 = MAINS	
X9 = RAM BAT-	X19 = MAINS	X29 = R2 Vp	X39 = A-socket	
X10 = RAM BAT+	X20 = 0 V ⏚	X30 = R2 Vp	X40 = MAINS	



PC BOARD VERSION NUMBER

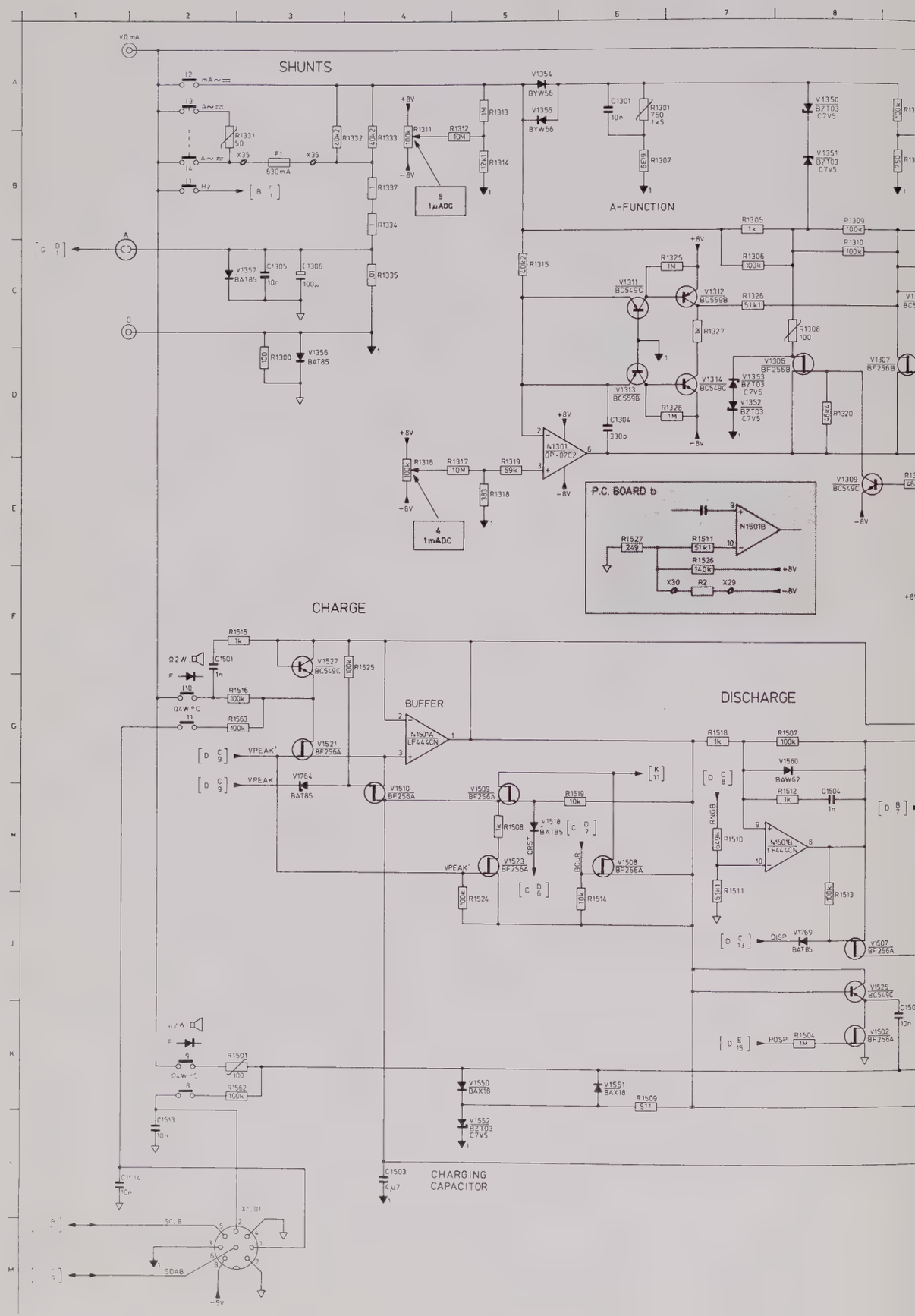
□ = ADJUSTMENT AND NUMBER

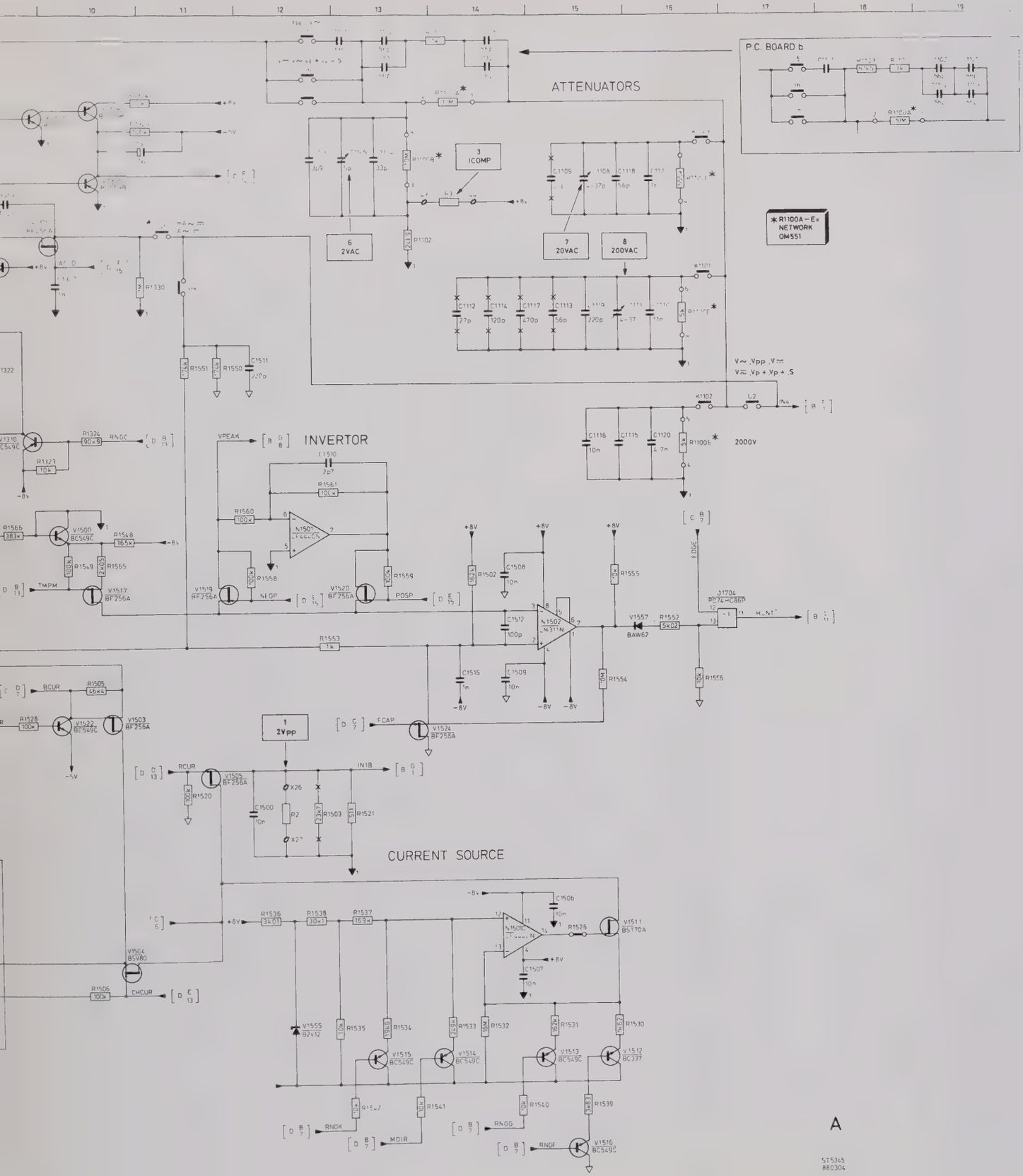
P.C. BOARD B.
COMPONENT SIDE



PARTS LOCATION

P.C. BOARD B. (A.)
COMPONENT SIDE


SHUNTS
A-FUNCTION
P.C. BOARD b
CHARGE
BUFFER
DISCHARGE
CHARGING CAPACITOR
1 µADC
1 mADC
BYW56
BZT03 C7V5
BC549C
BC559B
BF256A
BF256B
BAT85
BAW62
BAX18
LF442CN
OP-07C/Z
N1501A
N1501B
N15018
R1301 750 1%5
R1331 50
R1332 4.06k2
R1333 4.06k2
R1334 1
R1335 0Ω1
R1337 1
R1311 100k
R1312 10M
R1313 1M
R1314 12k1
R1315 4.06k2
R1316 100k
R1317 10M
R1318 383
R1319 59k
R1320 4.64k
R1325 1M
R1326 51k1
R1327 1k
R1328 1M
R1305 1k
R1306 100k
R1307 68E9
R1308 100
R1309 100k
R1310 100k
R1300 100
R1501 100
R1562 100k
R1563 100k
R1515 1k
R1516 100k
R1525 100k
R1527 249
R1511 51k1
R1526 140k
R1518 1k
R1507 100k
R1512 1k
R1504 1M
R1519 10k
R1508 1k
R1524 100k
R1514 10k
R1509 511
R1513 100k
C1301 10n
C1304 330p
C1305 10n
C1306 100µ
C1501 1n
C1503 1µ47
C1504 1n
C1513 10n
C1514 10n
C1502 10n
V1354 BYW56
V1355 BYW56
V1350 BZT03 C7V5
V1351 BZT03 C7V5
V1352 BZT03 C7V5
V1353 BZT03 C7V5
V1357 BAT85
V1356 BAT85
V1311 BC549C
V1312 BC559B
V1313 BC559B
V1314 BC549C
V1306 BF256B
V1307 BF256B
V1309 BC549C
V1527 BC549C
V1521 BF256A
V1510 BF256A
V1764 BAT85
V1509 BF256A
V1518 BAT85
V1523 BF256A
V1508 BF256A
V1560 BAW62
V1769 BAT85
V1507 BF256A
V1525 BC549C
V1502 BF256A
V1550 BAX18
V1551 BAX18
V1552 BZT03 C7V5
F1 630mA
X35
X36
X30
X29
R2
VPEAK
VPEAK'
DISP
POSP
RNGB
CRS'
RCLR
SCLB
SDAB
-5V



A

5T5345
880304

NI ANALOG A

DIGITAL

KEYBOARD RESET

RESET

FUNCTION DECODING

A SOCKET

ADDRESS LATCH

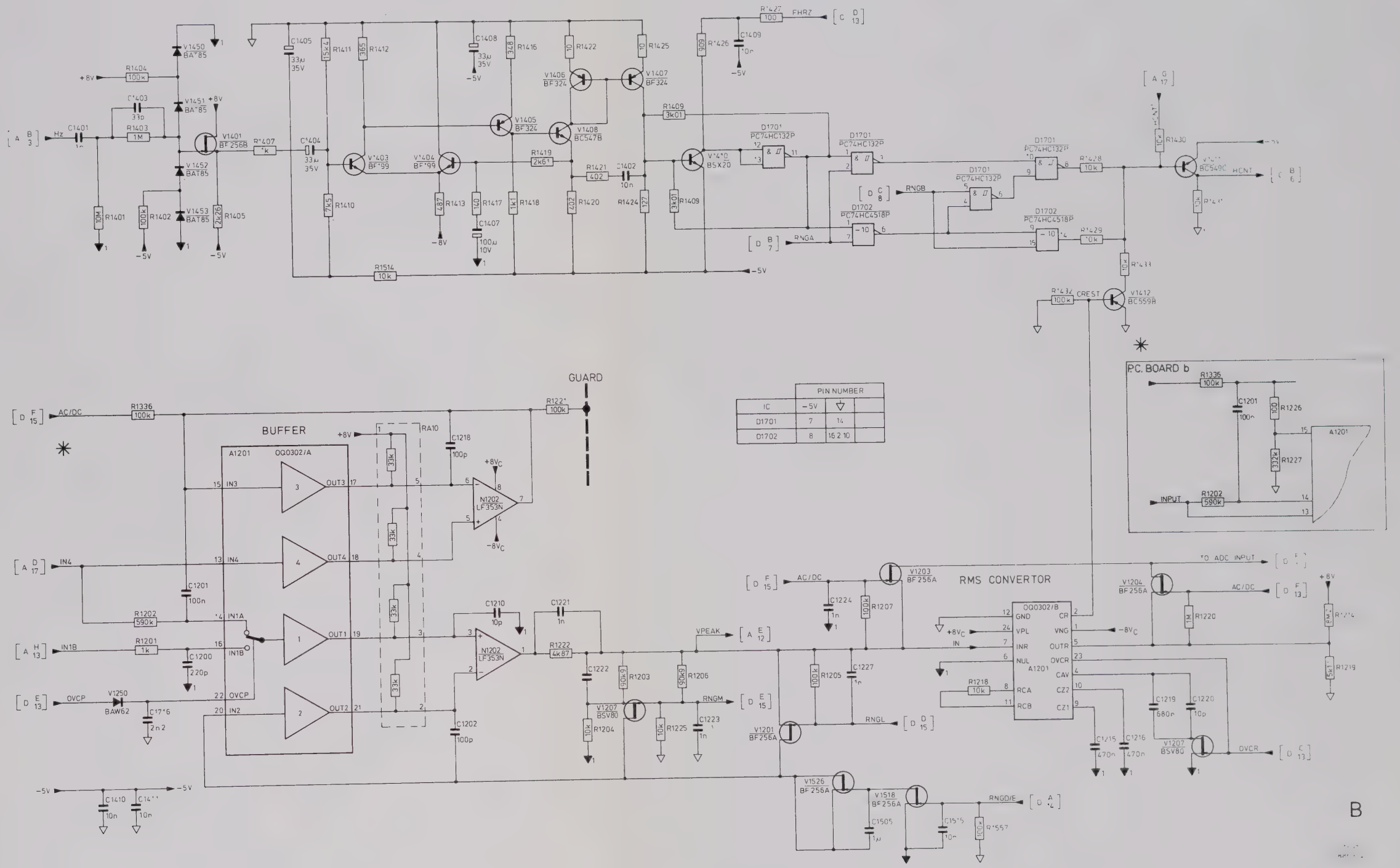
ROM

RAM

ADDRESS-BUS

DATA-BUS

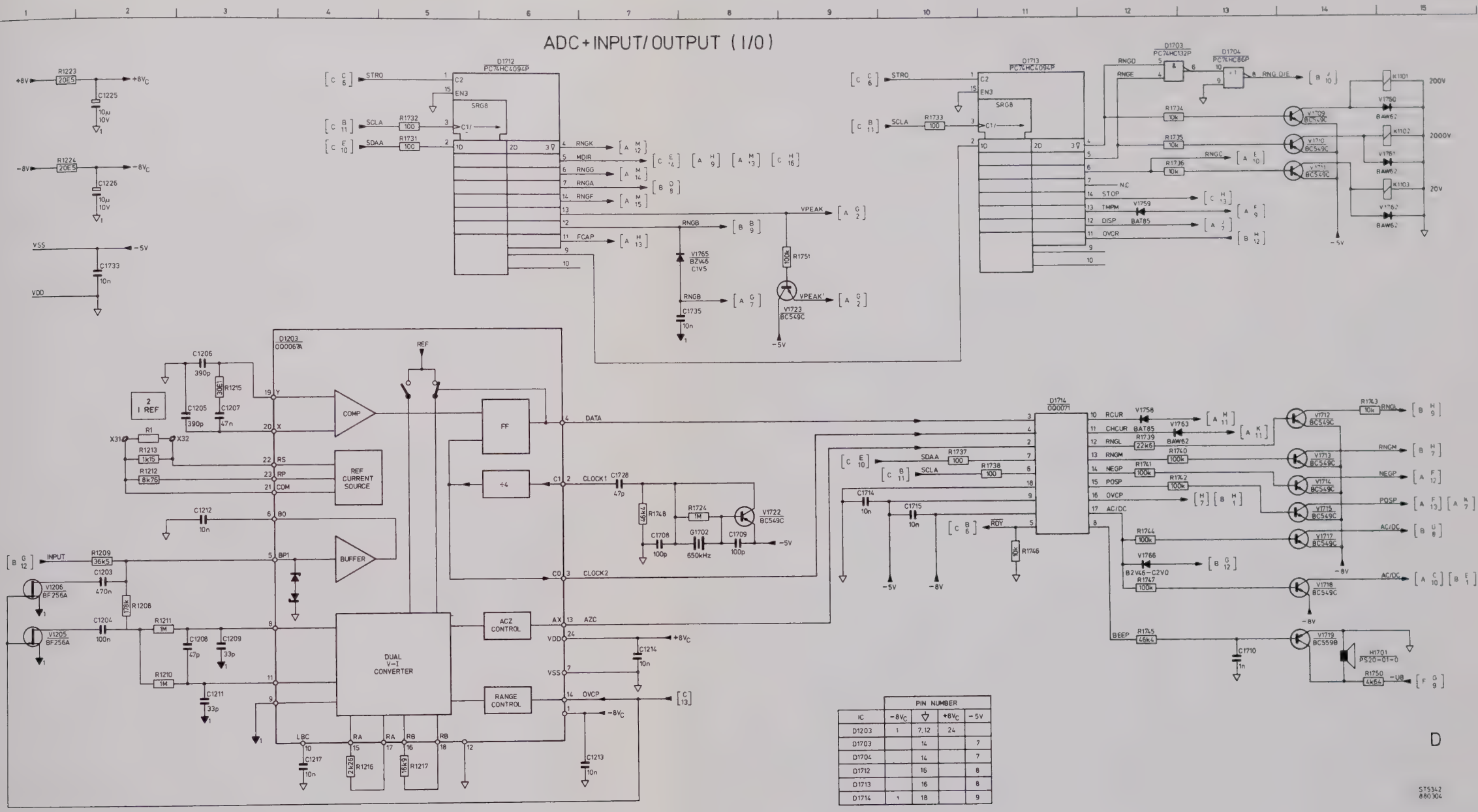
IC	PIN NUMBER		
	-5V		0VCC
D1703	7	14	
D1704	7	14	
D1705	7	14	
D1706	20		40
D1707	8	16	
D1709	10		20
D1710	14		28
D1711	12		24


BUFFER
A1201 OQ0302/A
GUARD
RMS CONVERTOR
OQ0302/B
P.C. BOARD b
AC/DC
RNGA
RNGB
RNGM
RNGL
RNGD/E
VPEAK
CREST
HCNT
FHRZ
OVCP
OVCR
INPUT
TO ADC INPUT
PIN NUMBER
IC | -5V | ▽
D1701 | 7 | 14
D1702 | 8 | 16 2 10

B

NI ANALOG B

ADC + INPUT/OUTPUT (I/O)



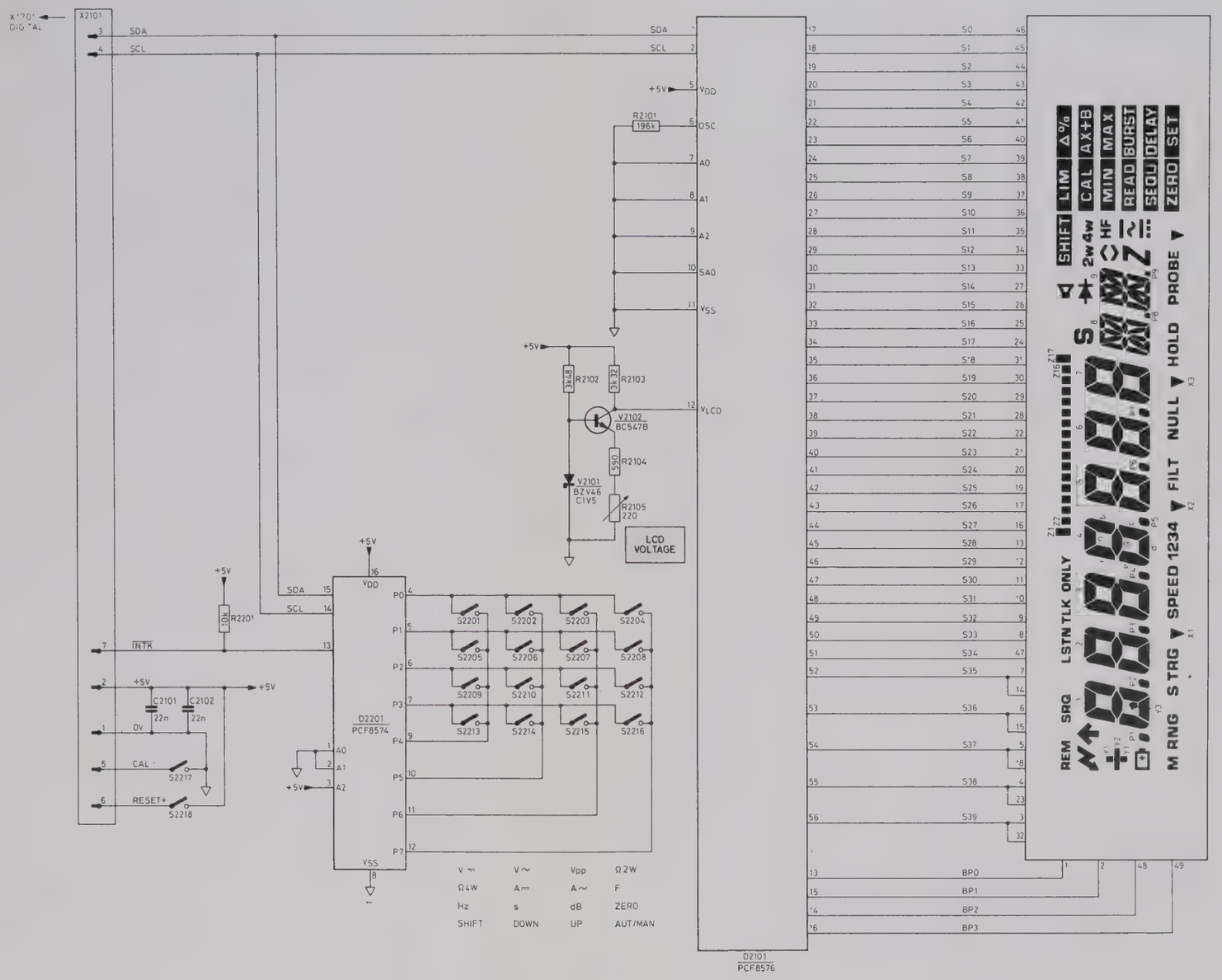
IC	PIN NUMBER			
	$-8V_C$	⏚	$+8V_C$	-5V
D1203	1	7,12	24	
D1703		14		7
D1704		14		7
D1712		16		8
D1713		16		8
D1714	1	18		9

D

ST5342
880304

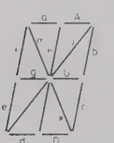
ADC I/O D

DISPLAY



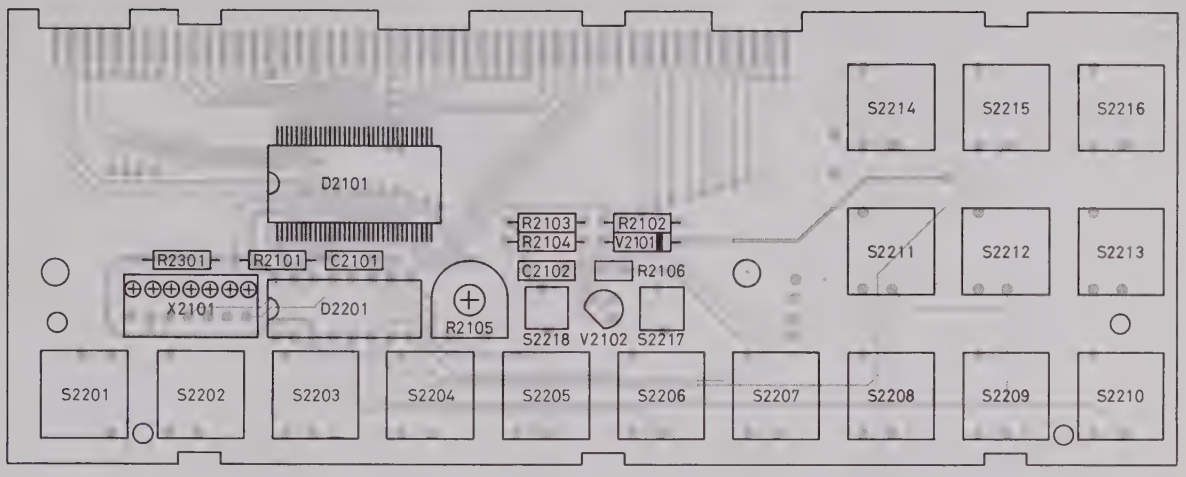
LX DISPLAY

	MSB			LSB	
S0	—	~	DELAY	SEQU	MS NIBBLE
S1	BURST	MAX	Δ %	AX+B	LS NIBBLE
S2	READ	MIN	CM	CA	
S3		4W		SHIFT	
S4	—	HF		2W	
S5	P8P9	Z		V	
S6	D9	C9	A9	b9	
S7	k9	G9	m9	i9	9
S8	9	9	m9	g9	
S9	d9	e9	a9	f9	
S10	D8	C8	A8	b8	
S11	k8	G8	h8	8	
S12	i8	8	m8	g8	
S13	d8	e8	a8	f8	
S14	Z14	Z15	Z17	Z16	
S15	Z13	Z12	Z10	Z11	
S16	Z6	Z7	Z9	Z8	
S17	Z5	Z4	Z2	Z3	
S18	d7	c7	a7	b7	
S19	P7	e7	f7	g7	
S20	d6	c6	a6	b6	
S21	P6	e6	f6	g6	
S22	d5	c5	a5	b5	
S23	P5	e5	f5	g5	
S24	d4	c4	a4	b4	
S25	P4	e4	f4	g4	
S26	d3	c3	a3	b3	
S27	P3	e3	f3	g3	
S28	d2	c2	a2	b2	
S29	P2	e2	f2	g2	
S30	d1	c1	a1	b1	
S31	Y3	e1	f1	g1	
S32	P1	Y2	SRQ		
S33		Y1	REM		
S34			SET	ZERO	
S35	X1	STRG	LSTN	MRNG	
S36	SPEED	1	TLK	2	
S37	X2	4	ONLY	3	
S38	FILT	NULL	Z1	X3	
S39	X4	PROBE	S	HOLD	
	BP0	BP1	BP2	BP3	



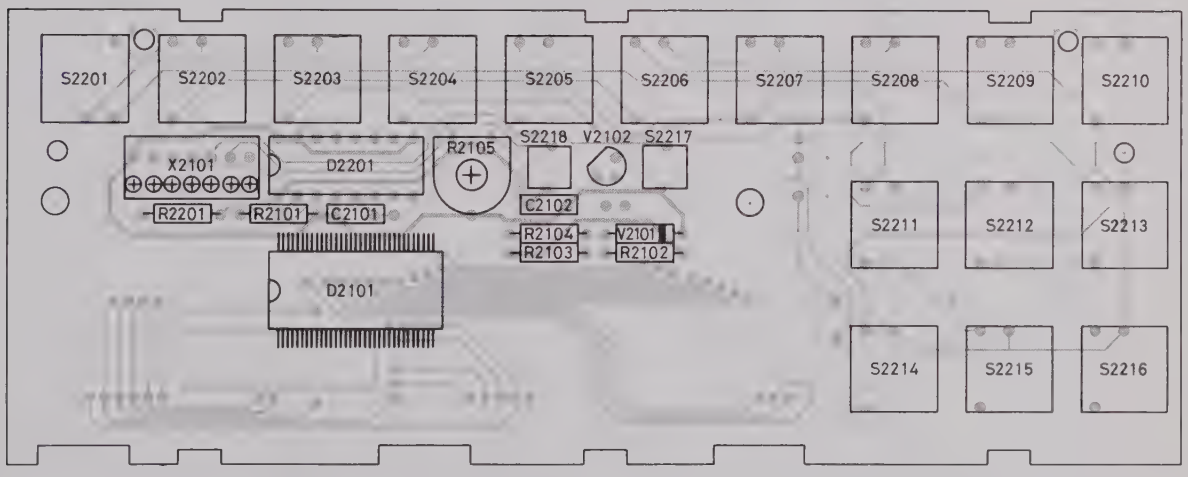
E

N22 DISPLAY E



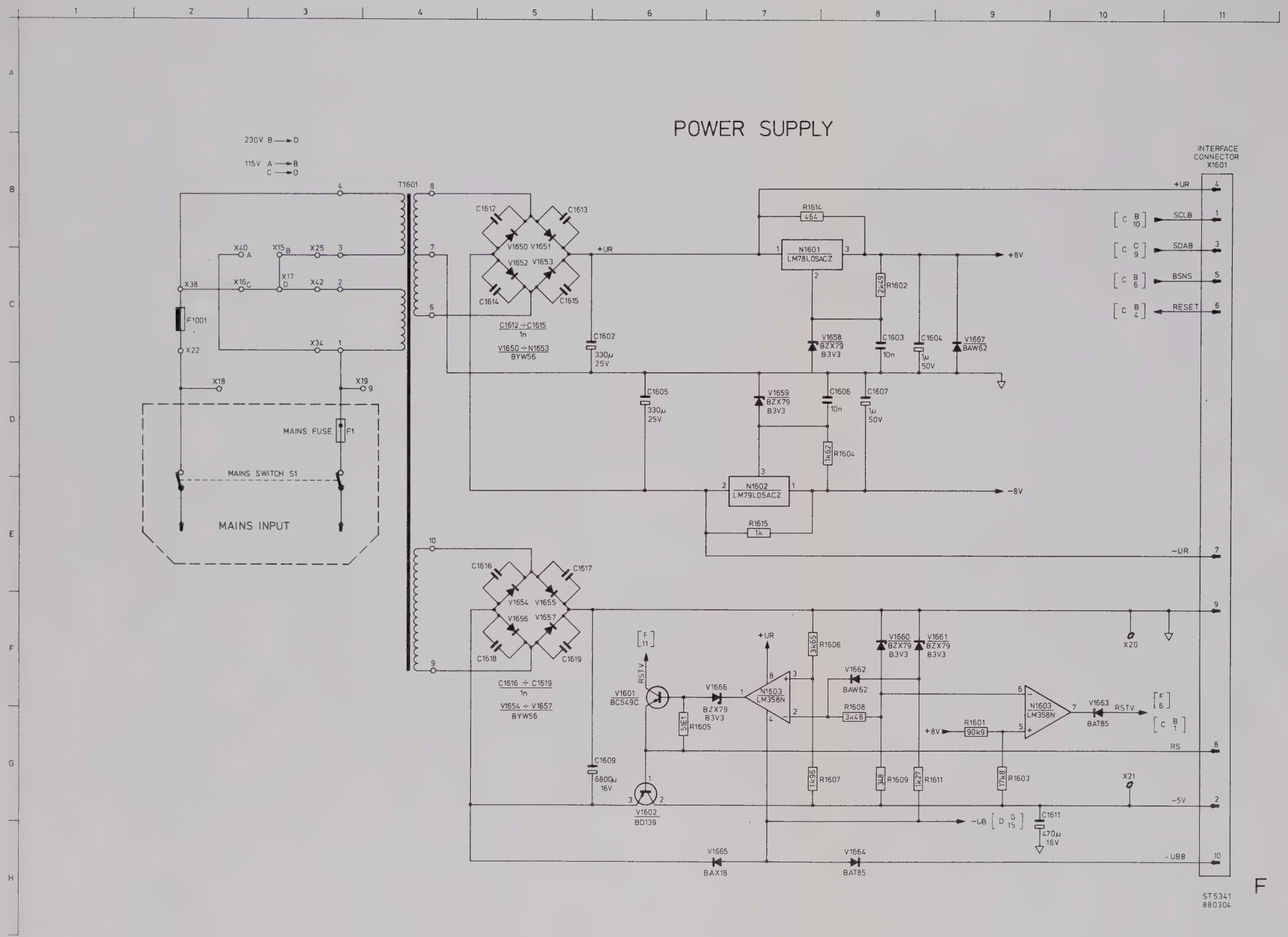
ST4739
850809

N22 DISPLAY PCB, COMPONENT SIDE

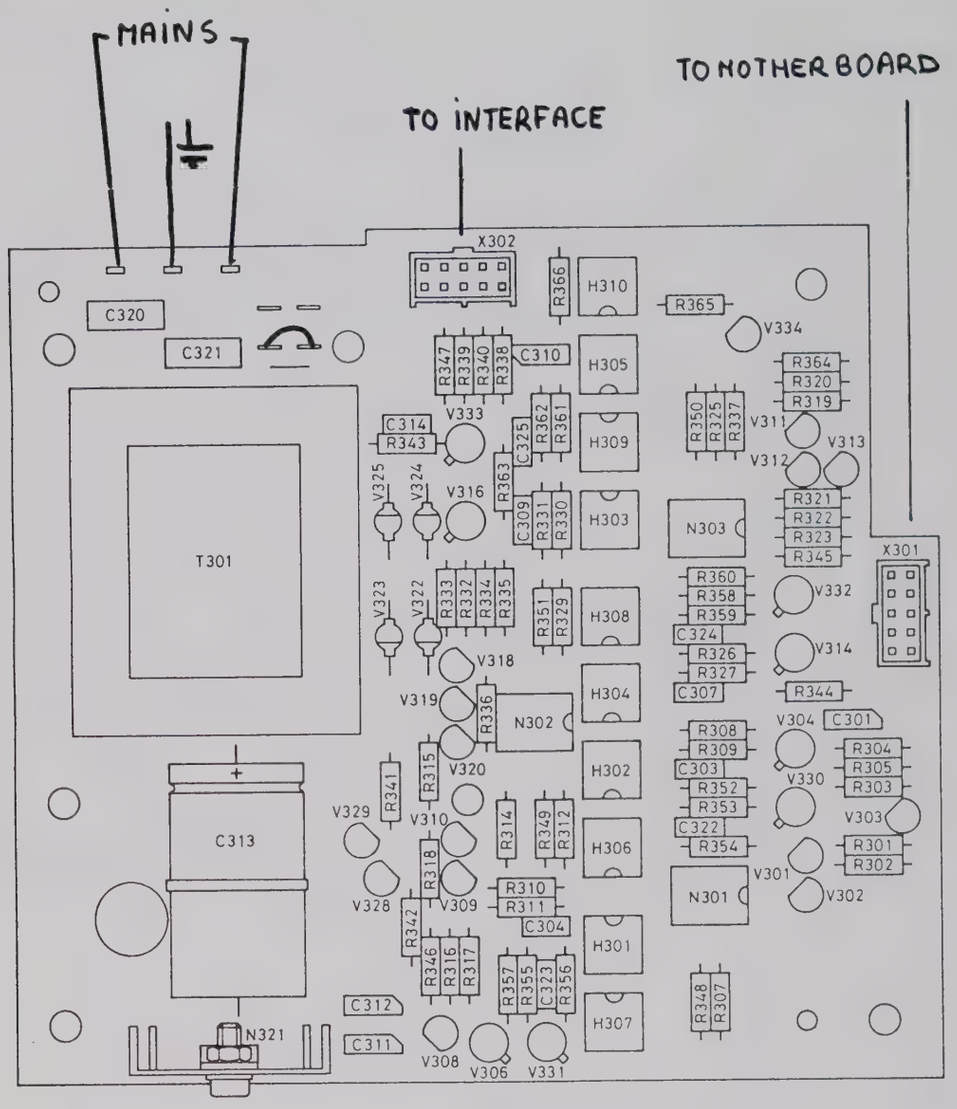


ST4801
860305

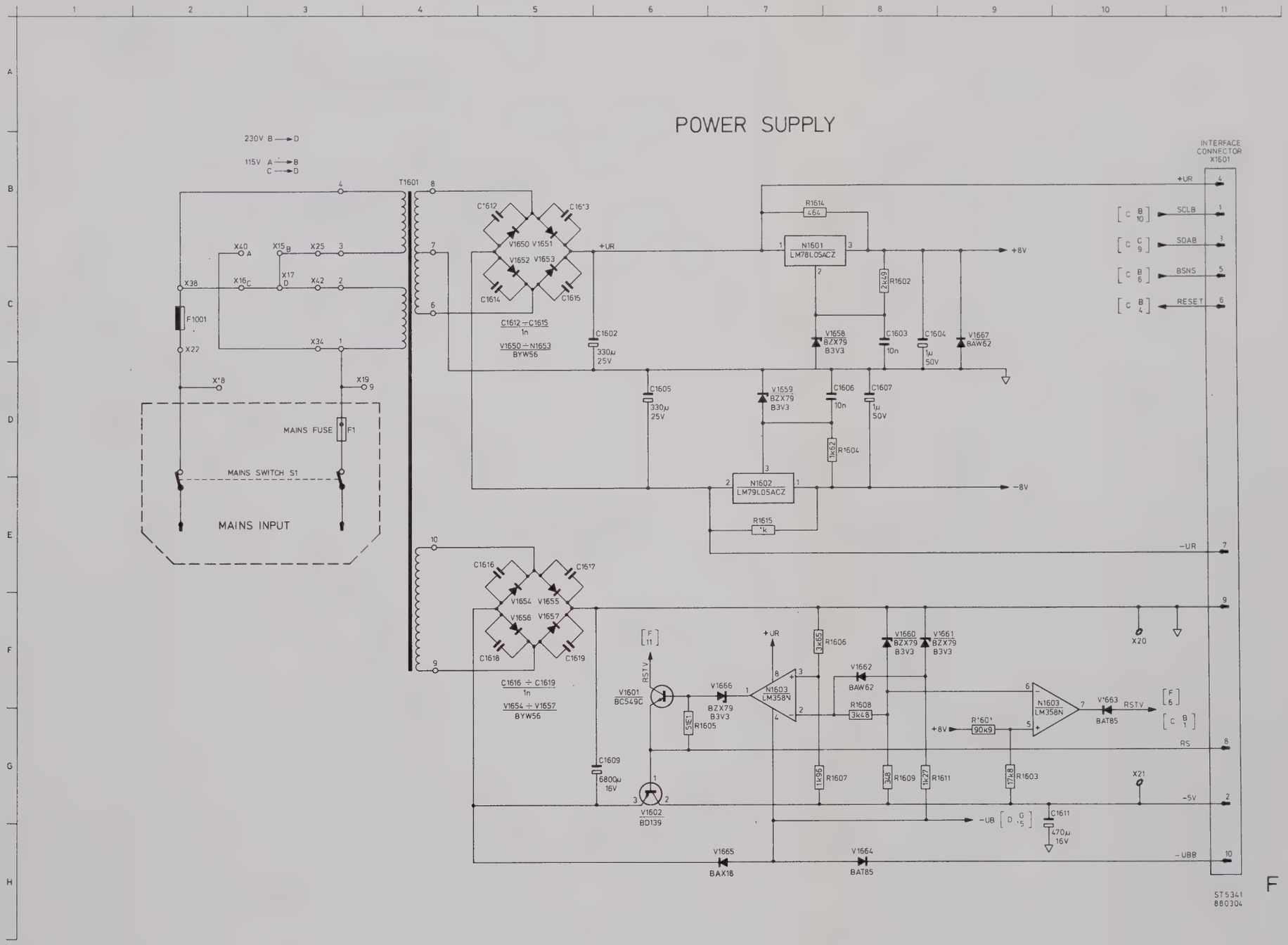
N22 DISPLAY PCB, CONDUCTOR SIDE



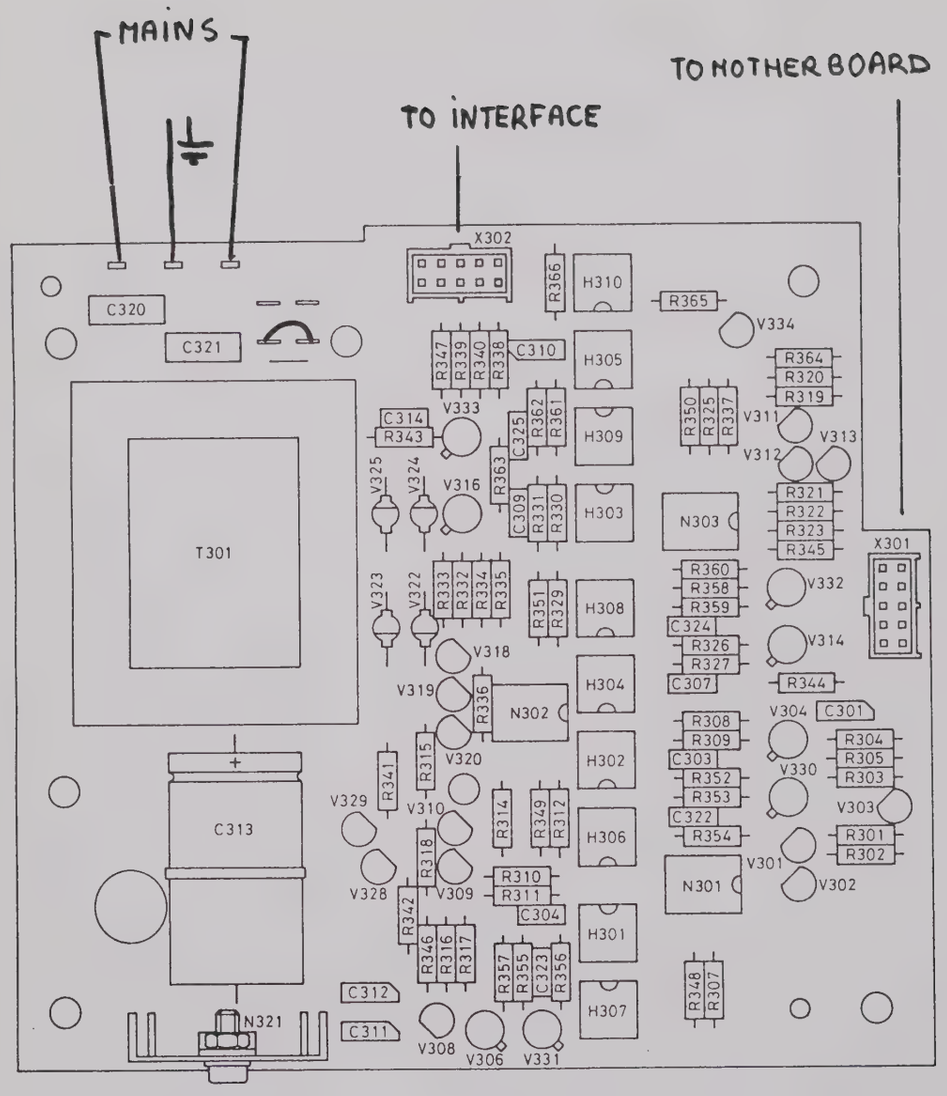
POWER SUPPLY F



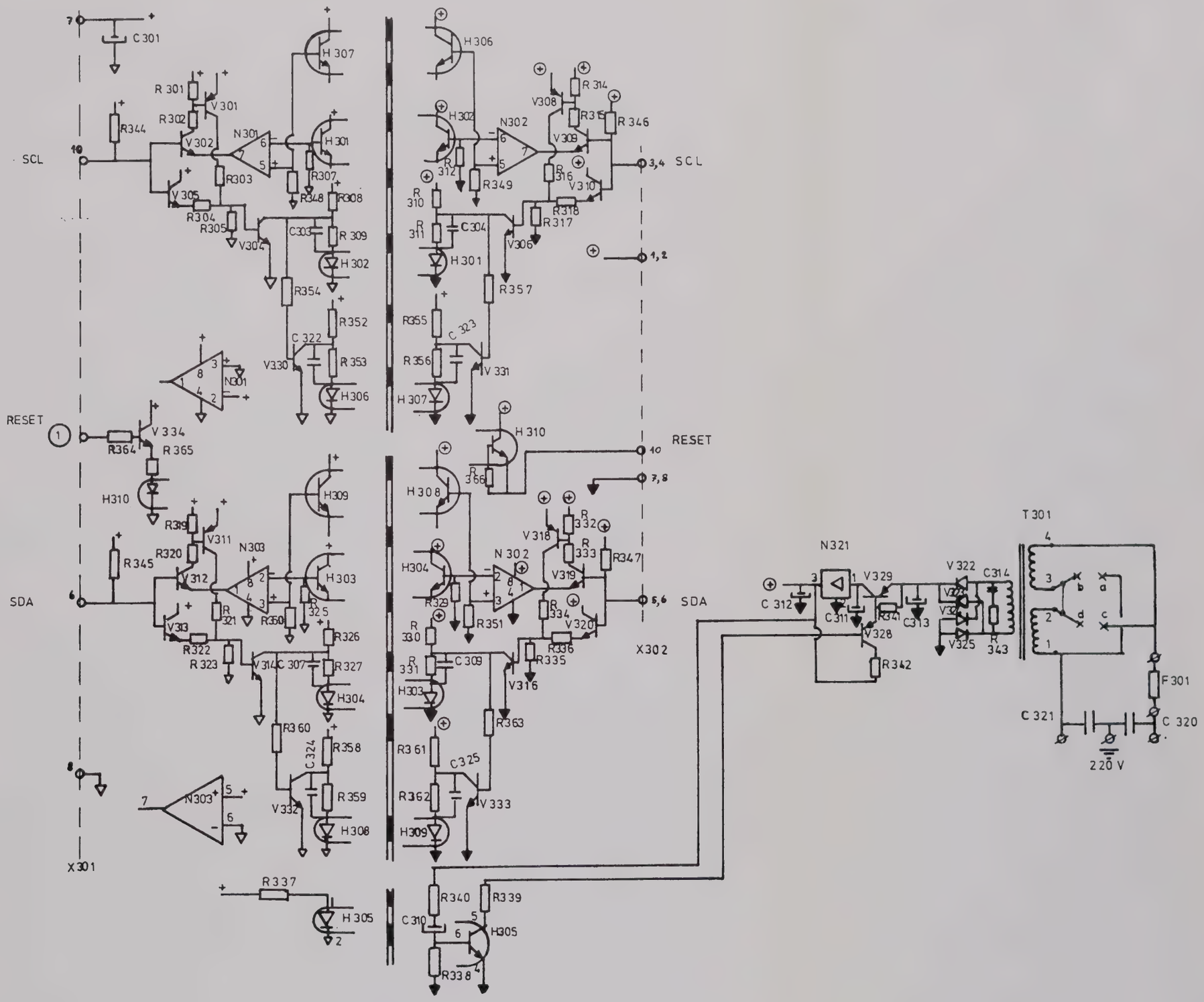
N3 GALVANIC SEPARATION PM2525/51, /61, /71



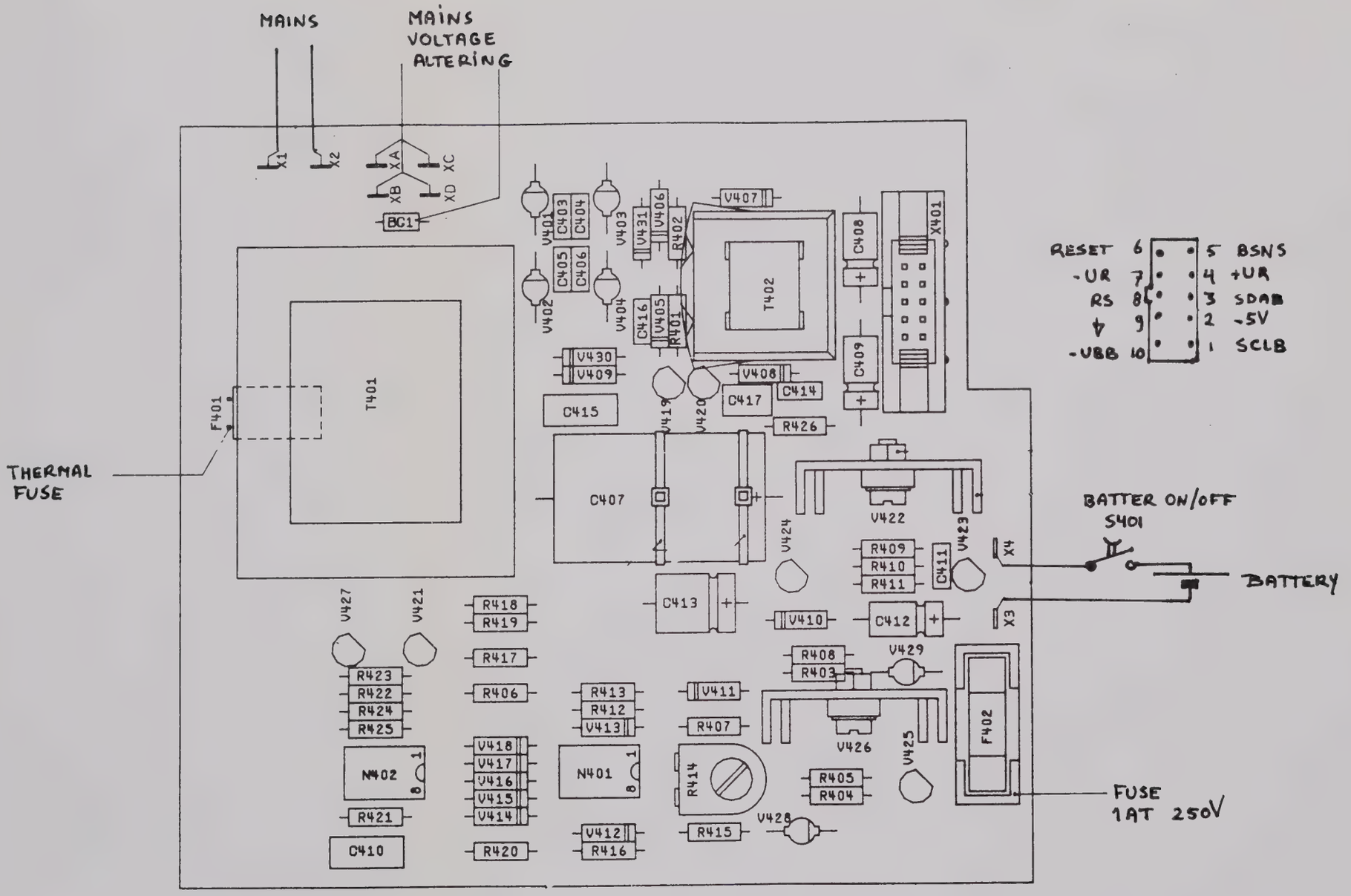
POWER SUPPLY F



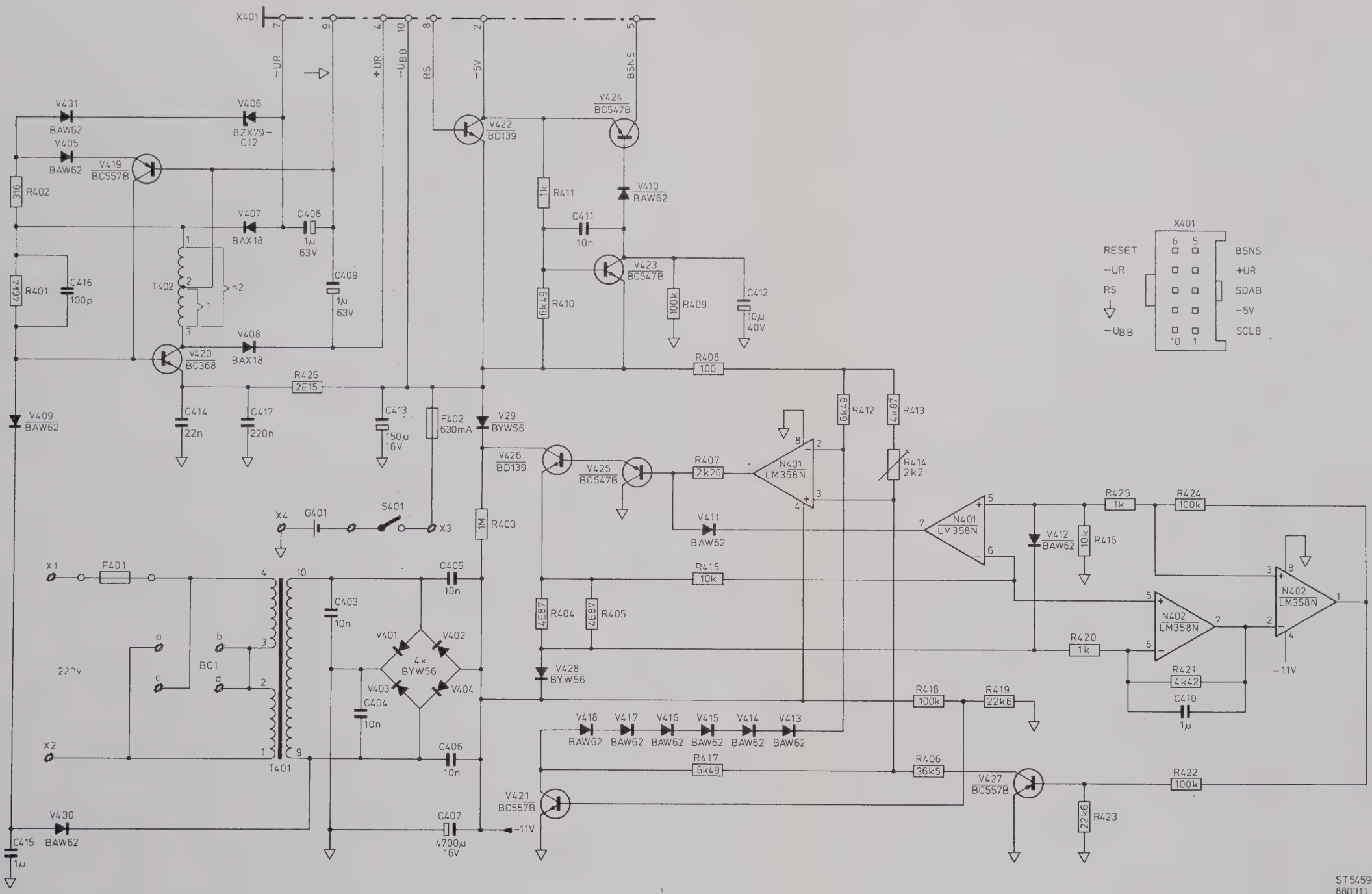
N3 GALVANIC SEPARATION PM2525/51, /61, /71



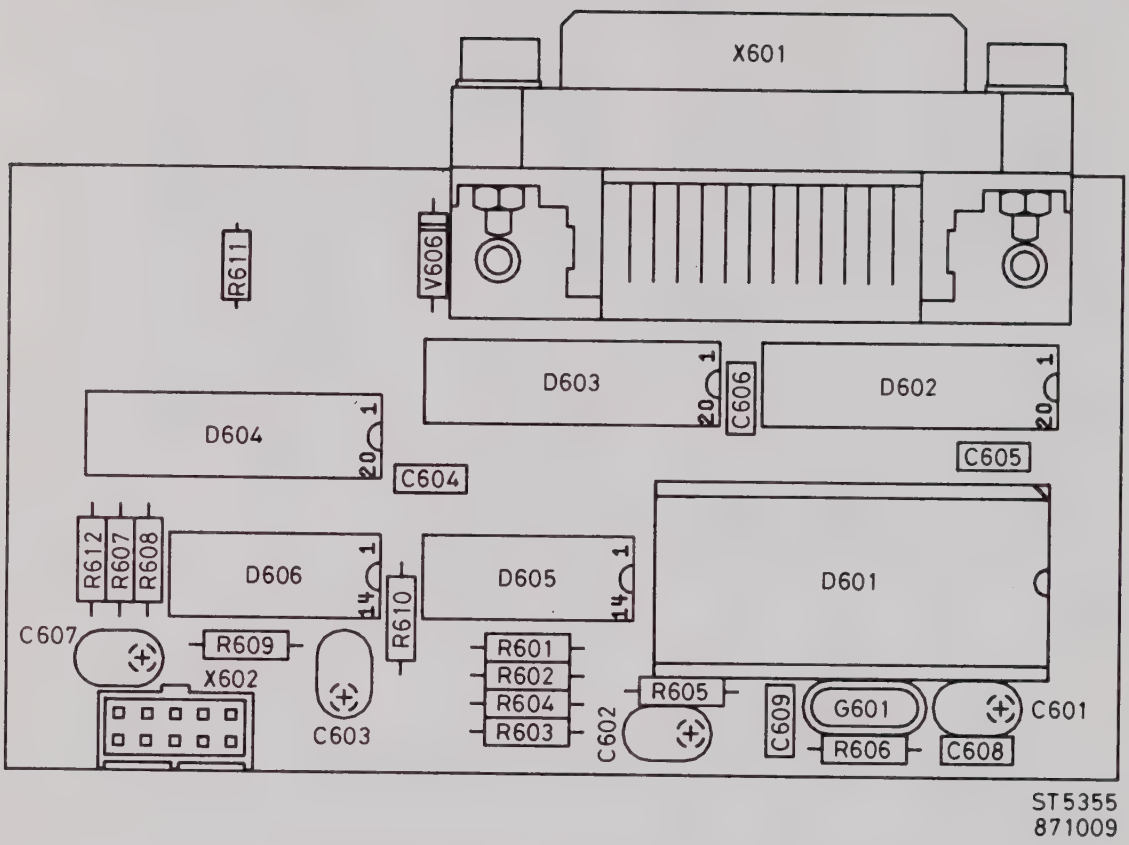
N3 GALVANIC SEPARATION PM2525/51, /61, /71



N4 BATTERY VERSION PM2525/21



N4 BATTERY P.C. BOARD PM2525/21

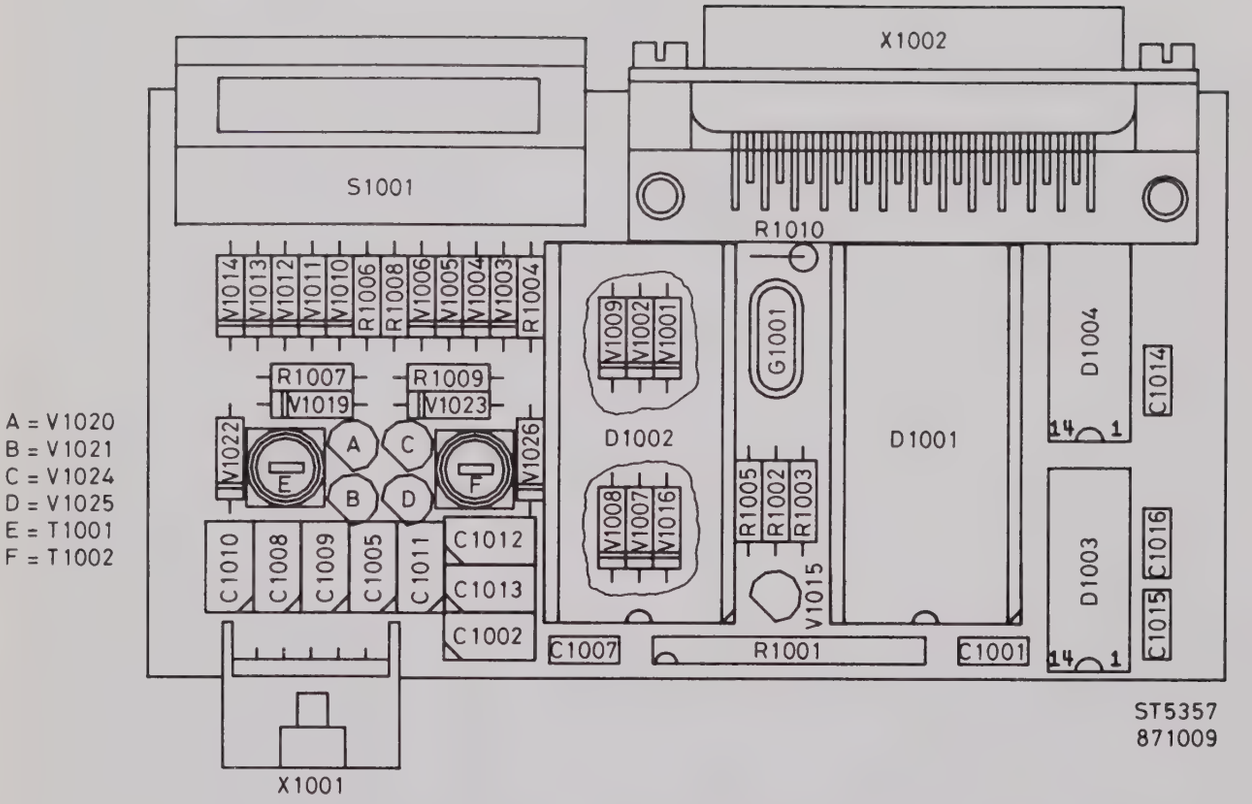


N6 IEEE-488/IEC-625 INTERFACE PM2525/51

IIC

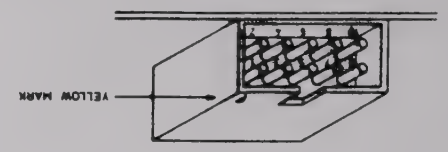
IEEE 488

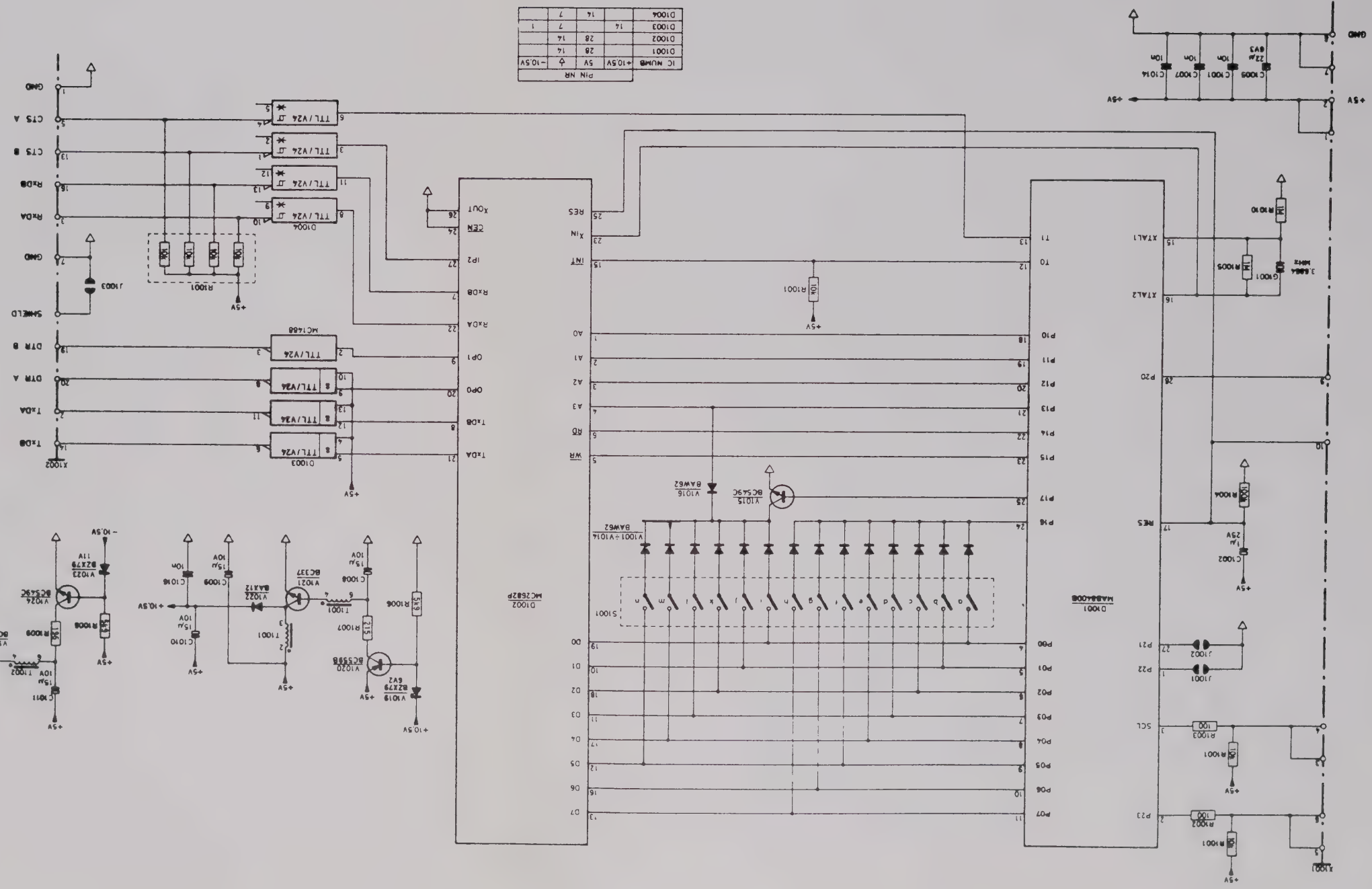
N6 IEEE-488/IEC-625 INTERFACE PM2525/51

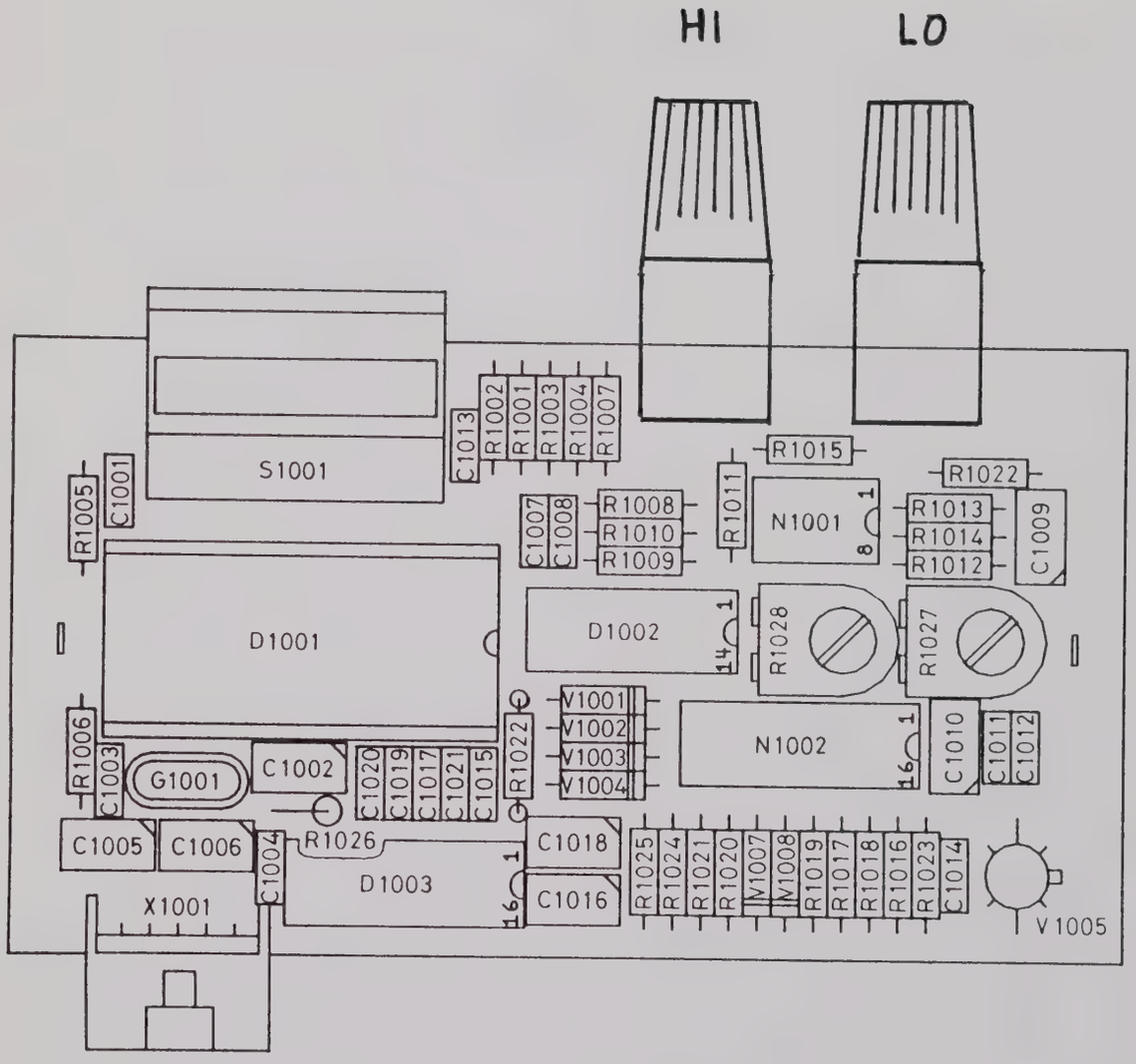


A = V1020
B = V1021
C = V1024
D = V1025
E = T1001
F = T1002

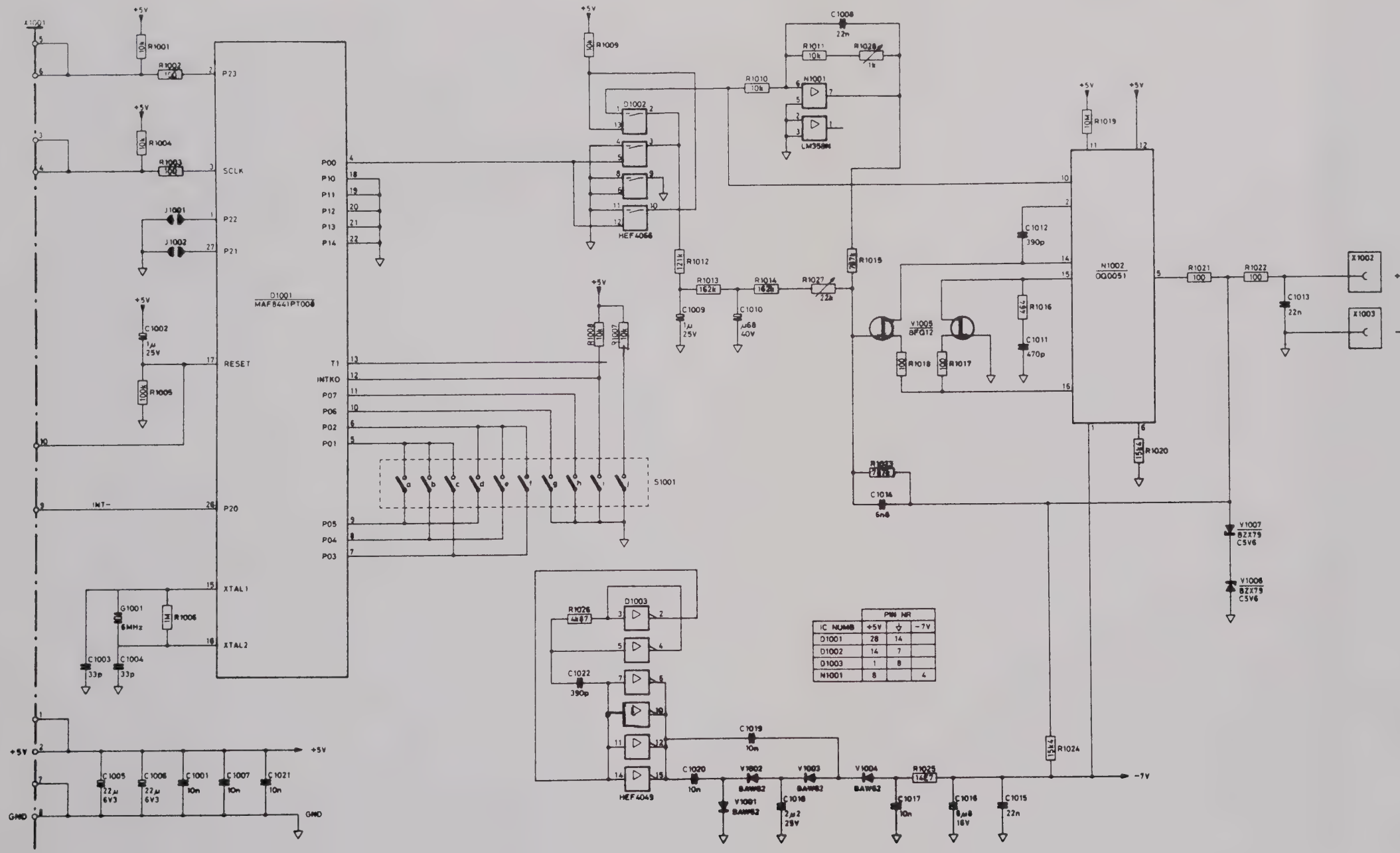
N10 (N21000) RS232/V24 INTERFACE PM2525/61

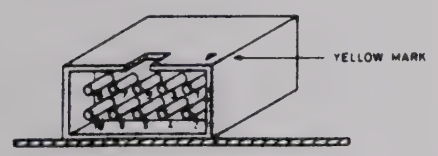

YELLOW MARK


GND
+5V
C1005
C1001
C1007
C1014
10n
10n
10n
22µ
6V3
R1010
1M
3.6864
MHz
G1001
R1005
1M
XTAL1
XTAL2
P20
RES
R1004
25V
C1002
P21
P22
J1002
J1001
SCL
R1003
100
R1001
10k
P23
R1002
100
R1001
10k
X1001
D1001
MAB8400B
T1
T0
P10
P11
P12
P13
P14
P15
P17
P16
P00
P01
P02
P03
P04
P05
P06
P07
R1001
10k
+5V
V1001÷V1014
BAW62
V1015
BC549C
V1016
BAW62
S1001
D1002
MC2682P
AD
A1
A2
A3
RD
WR
D0
D1
D2
D3
D4
D5
D6
D7
XOUT
CEN
XIN
RES
INT
IP2
RxDB
RxDA
OP1
OP0
TxDB
TxDA
R1001
+5V
D1004
TTL/V24
TTL/V24
TTL/V24
TTL/V24
SHIELD
GND
CTS A
CTS B
RxDB
RxDA
GND
J1003
SHIELD
DTR B
DTR A
TxDA
TxDB
X1002
D1003
MC1488
TTL/V24
TTL/V24
TTL/V24
TTL/V24
+5V
PIN NR
IC NUMB
D1004
D1003
D1002
D1001
+10.5V
5V
0
-10.5V
14
7
28
14
7
1
-10.5V
+10.5V
C1016
10n
C1009
15µ
10V
V1022
BAX12
BC337
V1021
C1008
15µ
10V
T1001
R1007
2k15
BC559B
V1020
R1006
5k6
V1019
BZX79
6V2
+10.5V
C1010
15µ
10V
T1002
C1011
15µ
10V
V1024
BC546C
V1023
BZX79
11V
R1008
5k6
C1013
15µ
16V
V1025
BAX12
C1012
15µ
10V
C1015
10n
-10.5V



N10 (N11000) ANALOG OUTPUT PM2525/71





N10 (N11000) ANALOG OUTPUT PM2525/71

10. GLOSSARY OF TERMS

LETTER	NAME	LOCATION	DESCRIPTION
A	AD0-AD7	D1706 uP	ADDESS/DATA
	A0-A15	D1706 uP	ADDRESS
	AC/DC	V1717/C	SWICHING POINT FROM DC TO AC FUNCTION AROUND THE RMS CONVERTOR
	ALE	D1706/30	ADDRESS LATCH ENABLE
	AZC	A1203/13	AUTO ZERO COMPENSATION FOR ANALOG TO DIGITAL CONVERTOR (ADC) OQ0067
B	BCUR	D1706/6	BYPASS CURRENT IN FUNCTION VPEAK (PASSES CURRENT TO N1501A/1)
	BEEP	D1714/8	BEEPER SIGNAL
	BP1	A1203/5	BUFFER AND PROTECTION INPUT OQ0067
	BSNS	D1706/10	BATTERY SENSE FOR /21 BATTERY VERSION
	BO	A1203/6	BUFFER OUTPUT OQ0067
C	CAV	A1201/4	AVERAGING CAPACITOR OQ0302
	CAL	X1701/5	CALIBRATION SIGNAL FROM CAL FRONT SWITCH
	$\overline{CE}$	D1710/20	CLEAR ENABLE FOR ROM
	CHCUR	D1714/10	CHARGE CURRENT FOR CAPACITY FUNCTION (CX) AND MEASURING CURRENT FOR RESISTANCE
	COM	A1203/21	COMMON POINT FOR CURRENT SOURCE RESISTOR OQ0067
	CR	A1201/2	CREST FACTOR INDICATION OQ0302
	CRST	D1706/5	(CESTFACTOR) CHARGE CURRENT VPEAK (C1503 4us)
	CZ1	A1201/9	AUTO ZERO CAPACITOR 1 OQ0302
	CZ2	A1201/10	AUTO ZERO CAPACITOR 2 OQ0302
	CLK1	A1203/2	ADC CLOCK INPUT OQ0067
	CLK2	A1203/3	ADC CLOCK OUTPUT (INPUT :4) OQ0067
	CLOCK1	A1203/2	ADC CLOCK INPUT OQ0067
	CLOCK2	A1203/3	ADC CLOCK OUTPUT (INPUT :4) OQ0067

D	D0-D7	D1710/11-29	DATA
	DATA	A1203/4	ADC DATA OUTPUT OQ0067
	DISP	D1713/12	DISCHARGE CX (CAPACIY MEASUREMENTS) AND DISCHARGE C1503 IN VPEAK MEASUREMENTS
E	EDGE	D1706/11	EDGE DETERMINE FOR TIME MEASUREMENTS
F	FIHI	D1707/11	FUNCTION HIGH CURRENT
	FILO	D1707/12	FUNCTION LOW CURRENT
	FHRZ	D17107/13	FUNCTION HZ
	FVAC	D1707/14	FUNCTION VOLT AC
	FVDC	D1707/3	FUNCTION VOLT DC
	FRTW	D1707/4	FUNCTION RESISTANCE TWO WIRE
	FRFW	D1707/5	FUNCTION RESISTANCE FOUR WIRE
	FCAP	D1712/11	FUNCTION CAPACITY
G			
H	HCNT	D1706/14	HERZ, CREST, TEMPERATURE, VPEAK COMBINATION
	HCUR	D1706/7	HIGH CURRENT (10A SOCKET)
I	INPUT	D1201/13	INPUT SIGNAL FOR RMS-CONVERTOR OQ0302
	IN1A	A1201/14	INPUT SOURCE-FOLLOWER 1A OQ0302
	IN1B	A1201/16	" 1B "
	IN2	A1201/20	" 2 "
	IN3	A1201/15	" 3 "
	IN4	A1201/13	" 4 "
	INR	A1201/7	RMS CONVERTOR INPUT OQ0302
	$\overline{\text{INTK}}$	X1701/7	INTERRUPT KEYBOARD
	$\overline{\text{INTO}}$	D1706/12	INTERRUPT FOR TIMER T0 INSIDE uP
	$\overline{\text{INT1}}$	D1706/13	INTERRUPT FOR TIMER T1 INSIDE uP
J			
K			
L	LBC	A1203/10	LOW BUFFER CAPACITOR ADC OQ0067

M	MDIR	D1712/5	MOTOR DIRECTION
N	NEGP	R1506-D1714/14	NEGATIVE PEAK
	NUL	A1201/6	ANALOG ZERO RMS CONVERTOR OQ0302
O	OVCP	D1714/16	OFFSET VOLTAGE CONTROL PRE-AMPLIFIER OQ0302
	OUT1	A1201/19	OUTPUT SOURCE FOLLOWER 1 OQ0302
	OUT2	A1201/21	" 2 "
	OUT3	A1201/17	" 3 "
	OUT4	A1201/18	" 4 "
	OUTR	A1201/5	OUTPUT RMS CONVERTOR OQ0302
	OVCR	D1713/11	OFFSET VOLTAGE CONTROL RMS CONVERTOR OQ0302
	OLC	V1305/C	OVERLOAD CURRENT RANGES
	$\overline{OE}$	D1710/21	OUTPUT ENABLE ROM
	Ω	A1201/16	RESISTANCE INPUT FROM BUFFER OQ0302
P	$\overline{PGN}$	D1710/27	PROGRAM INPUT ROM
	POSP	D1714/15	POSITIVE PEAK
	$\overline{PSEN}$	D1706/19	PROGRAM STORE ENABLE uP
	P0-P3	D1706	INPUT/OUTPUT PORTS uP
R	RA	A1203/15/16	RANGE RESISTOR 0.1V ADC OQ0067
	RB	A1203/16/18	RANGE RESISTOR 1V "
	RS	A1203/22	SERIES RESISTOR ADC OQ0067
	RP	A1203/23	PARALLEL RESISTOR ADC OQ0067
	RCUR	D1714/10	REFERENCE CURRENT FOR CAPACITY MEASUREMENTS
	RESET	X1707/6	RESET FROM RESET SWITCH ON FRONT
	$\overline{RD}$	D1706/17	READ uP
	RD	D1706/17	READ uP
	$\overline{RDY}$	D1706/13	READY OQ0071
	RNGA	D1712/12	RANGE A SWITCHING SIGNAL
	RNGB	D1712/7	" B "

	RNGC	D1713/ 6	RANGE C SWITCHING SIGNAL
	RNGD	D1713/4	" D "
	RNGE	D1713/5	" E "
	RNGF	D1712/14	" F "
	RNGG	D1712/6	" G "
	RNGK	D1712/4	" K "
	RNGL	V1201/G	" L "
	RNGM	D1714/13	" M "
	RST	D1706/9	RESET INPUT uP
	RSTV	V1663/A	RESET VOLTAGE FROM POWER SUPPLY
	RSTR	D1711/18	RESET RAM
S	SDAA	D1706/8	SERIAL DATA "A" IIC
	SCLA	D1706/15	SERIAL CLOCK "A" IIC
	SDAB	D1706/2	SERIAL DATA "B" IIC
	SCLB	D1706/12	SERIAL CLOCK "B" IIC
	STOP	D1713/14	STOP MOTOR
	SHFR	D1706/1	SHIFT REGISTER D1707
	STRO	D1706/14	STROBE I/O
T	TO ADC	R1209	INPUT SIGNAL FOR ADC OQ0067
	TMPM	D1713/13	TEMPERATURE MEASUREMENTS (INTERNAL)
U			
V	VPEAK	D1712/13	VOLT PEAK (C1503 SWITCHED ON)
W	$\overline{\text{WDR}}$	D1706/3	WATCH DOG RESET
	$\overline{\text{WR}}$	D1706/16	WRITE FOR RAM
	WR	D1706/16	WRITE FOR RAM
X	XT1	D1706/19	X-TAL FOR uP
	XT2	D1706/18	X-TAL FOR uP
Y			